

Assembly, Erection and Removal of Standardized Metal Forms

Use of Horizontal and Vertical Liners to Align Wall Forms—Liners Fastened with Eccentric Clamps—Units Removed and Re-erected in Courses

By B. E. WILTSHECK

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In the June issue of "Concrete" the author described the use of metal form units in constructing the concrete foundation walls of the Morgandale High School, in Milwaukee.

Because not all contractors are familiar with the use of metal forms, considerable space was devoted in the June installment to a description of the units themselves, and to the manner in which they are employed in forming around wall columns and pilasters, wall offsets, bays, corners and ledges. Special corner devices and fractional form units also were described and illustrated.

This issue tells how the standardized metal form units were assembled, erected and removed on the Morgandale High School work.—The Editors.

IN the first of these two articles describing the use of metal forms in the construction of the foundation walls of Morgandale High School, in Milwaukee, the writer described the standard size and fractional form units themselves, and the manner in which they can be used to form corners, offsets, pilasters, and so on. The forming of ledges in walls, and the use of special corner units were described and illustrated. The reader will recall that the standard units of the kind employed on this work are 24 inches square, but that fractional units also are supplied. The fractional units are made 24 inches high, but in widths including every inch from 2 to 8 inches, and every even inch from 8 to 22 inches, inclusive. With the use of these fractional units we were able to fit the forms to any dimension, either horizontal or vertical.

Spacing the Liners

The metal form units were aligned by means of 2-by-4 horizontal and vertical liners. The horizontal liners, as shown in Figure 6, were spaced 2 feet apart. That is, a horizontal liner was placed near the top of each course of forms, just above the top clamp and just below the crimp in the stiffener angles. Vertical liners, also 2-by-4's, were placed 4 to 6 feet apart.

How the Liners Were Fastened

Examination of Figure 6 shows that both the horizontal and vertical 2-by-4 liners were fastened to the form units with steel hooks, which in turn were tightened with eccentric clamps. To be more exact, the horizontal liners were clamped to the metal forms and the vertical liners were clamped to the horizontal.

The exact manner in which the liners were fastened and tightened is shown in Figure 7; and it will be well also to refer to Figure 1, in the first of these articles, on page 18 of the June issue of CONCRETE. As there illustrated, and described in the text, the outstanding leg of each vertical stiffener angle has two holes near the top and two near the bottom. These holes, more especially the two at the top, supply a hold for the U-shaped hooks, which are hooked at each free end of the "U" in order to provide a grip. The two holes at the bottom were needed only in the case of the first, or starting, course of form units.

Figure 7 shows clearly how the horizontal liners were fastened to the form units by means of the U-shaped hooks just described, and tightened up by means of eccentric clamps which are hooked into the "U" and tightened by pushing the handle of the clamp against the back of the liner. Figure 7 likewise illustrates how the vertical liners were fastened to the horizontal liners, by means of U-shaped hooks and eccentric clamps similar to those employed in fastening the horizontal liners.

The first point to be watched in the erection of these

forms was to see that the first, or starting, course was true and level, and in perfect alignment. This point is highly important, for if the first course is not properly placed and leveled, it will be difficult to get the remaining courses into correct alignment. Conversely, if the first course is properly placed, the remaining courses can be aligned without difficulty.

Mention was made in the first article, in the June issue, of the manner in which holes in the vertical stiffener angles on one edge of a form unit correspond to dowels in the angle on the opposite edge. As the units are set up one by one, the dowels in one unit slip into the holes of another, thereby maintaining alignment between units in the same course. Similarly, alignment is obtained between courses by means of cut iron spikes dropped into matched holes in the top angle of the lower unit and the bottom angle of the upper unit.

In erecting the forms for the first time we generally placed the form units into position one at a time, following along closely with the horizontal liners. The vertical liners, of course, were placed soon after the first course was in position. Material for the vertical liners was selected of a length at least equal to the full height of the wall.

Removing and Re-erecting

In removing the forms, the vertical, then the horizontal liners were taken down merely by loosening the holding clamps. Then the spreader ties were quickly twisted off with a wrench, the plate clamps knocked down and the plates are free. On some straight wall jobs it is possible to take down sections of about eight plates along a course, with the horizontal liners clamped in place, and so erect the section intact; but no great time saving is made on the average reinforced concrete structure, and it is not easy work to handle a 200-pound section above ground level.

As units are removed, each one that needs it is scraped free of hardened bits of concrete and surface oiled. This is an easy task that takes little time, and the effect of the oiling in the finished smoothness of the concrete wall surface and in preventing what little sticking of the steel surface to concrete there is, is very much worth while.

Handling Large Units

In some forms of structures, such as retaining walls, where the concrete is in large masses and the structure involves "straight-away" construction, it would be economical to provide the necessary rigging to handle the assembled forms in large panels. On building walls such as the foundation walls of this high school, however, with its many corners and offsets, nothing could have been gained by attempting to handle units in panels.

Bracing the Forms

Exterior bracing, in the ordinary sense of the term, obviously was not required on this work, since the steel spreader ties extending through the wall prevented the wall forms from bulging when fresh concrete was deposited. A certain amount of bracing was, of course, required to hold the wall forms in the proper position and to prevent the vibration due to placing concrete from jarring the forms out of alignment. For this purpose we

used 2-by-4's and 2-by-6's, nailed to the vertical liners near the top of the form work and to well set stakes.

Bulkheads Between One-Day Runs

When the form work for a day's run of concreting was set up, bulkheads were built into the forms at the end of the contemplated run. The location of the bulkhead was selected, whenever possible, at a pilaster or an offset, so as to avoid a conspicuous construction joint.

Material for Liners

The lumber for the liners must of necessity be dressed lumber of good quality, perfectly straight and reasonably rigid. Aside from the small quantity of lumber used for the top braces, no nails are driven into the liners, and little cutting is necessary. Because of these facts we select the liners with care and treat this lumber as a part of the form equipment.

The quantity of material required for liners and braces is about 1 bd. ft. to the sq. ft. of form area. This material, like the form units themselves, was used about five times on this high school job.

Rate of Placing Concrete

The concreting plant consisted of the usual hoist and chute for delivering concrete to a hopper on a centrally located platform, from where it was distributed by buggies.

With a plant of this kind we could ordinarily place 150 to 200 cubic yards in a day. This, however, would have necessitated the purchase of additional form units, which would have meant fewer re-uses on the high school job. As pointed out in the first installment, we used about 5,600 square feet of forms on this work, and the total contact form area was about 28,000 square feet, so that we obtained 5 uses of the forms and the liner material.

The point the writer wishes to emphasize here is that on a job of this kind, which involved the placing of only about 1,000 cubic yards of concrete, it was more economical to hold the rate of concreting down to about 80 cubic yards daily, thereby spreading the concreting operations over about 12 days, than it would have been to buy the additional forms and liners necessary for one-day runs of 150 or 200 cubic yards.

Naturally, on a project involving many thousands of cubic yards of concrete, the logical procedure would be to buy the additional form material necessary to run the concreting plant at full capacity.

Cost of the Form Work

The writer does not feel that a statement of actual cost of the form work on this contract would be of much value, for the reason that every job has its own peculiarities. For instance, the Morgandale High School job contained many wall pilasters, offsets, bays and corners, and many thin walls along ventilating ducts in which the form area was large in proportion to the quantity of concrete placed.

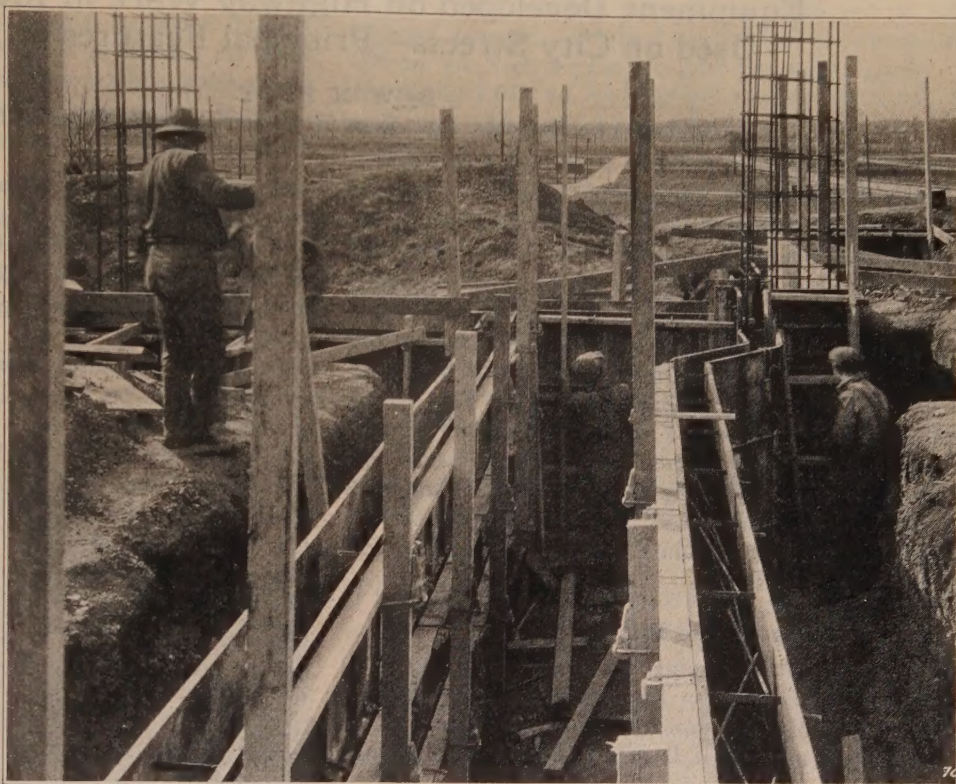
Even in determining the cost of the metal form units and the 2-by-4 liners and braces no two contractors would figure it quite the same way.

On this job we used the forms 5 times, as already stated, thereby cutting the cost per square foot of total

contact area down to one-fifth of the actual square foot cost of the metal forms. That is definite enough; but we charged the Morgandale job with only a part of the original cost of the forms and the liners, for the reason that the metal forms were practically as good as new and

have been if wooden forms of the usual type had been used; and, in addition, the work proceeded more smoothly and the appearance of the surface of the concrete was far more pleasing than would have been possible with wooden forms.

Figure 6. Perfect alignment of wall forms with metal form units and 2-by-4 liners. Observe clamps detailed in Figure 7



the liners were also good for much additional use. In matters of this kind the practice of contractors differs so materially that a statement of actual form costs on this work might be misleading.

On the other hand, the writer is free to say that the cost of the form work was substantially less than it would

Acknowledgments

The Wm. M. Christensen Construction Company, Inc., of Racine, Wisconsin, were the contractors on this work, and the metal forms were manufactured by the Metal Forms Corporation, of Milwaukee. The writer was superintendent of construction for the contractors.

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Error in Previous Installment

An unfortunate printing error in the first of these two articles, appearing in the first column on page 19 of the June issue, contained the statement that 56,000 sq. ft. of metal forms were used on the Morgandale High School work, whereas the correct figure is 5,600 sq. ft.

The point the writer wished to emphasize was that while the total contact form area on this work was 28,000 sq. ft., it was necessary to use only 5,600 sq. ft. of forms. Because of the ease with which the standardized forms could be removed and re-erected, it was possible on any given day to remove forms from the previous day's run of concreting and set them up for the next day's run.

By organizing the work in this manner it was, therefore, possible to use the metal forms 5 times on this contract.—The Author.

Additional articles covering the use of metal forms in other structural parts of buildings will appear in succeeding issues.

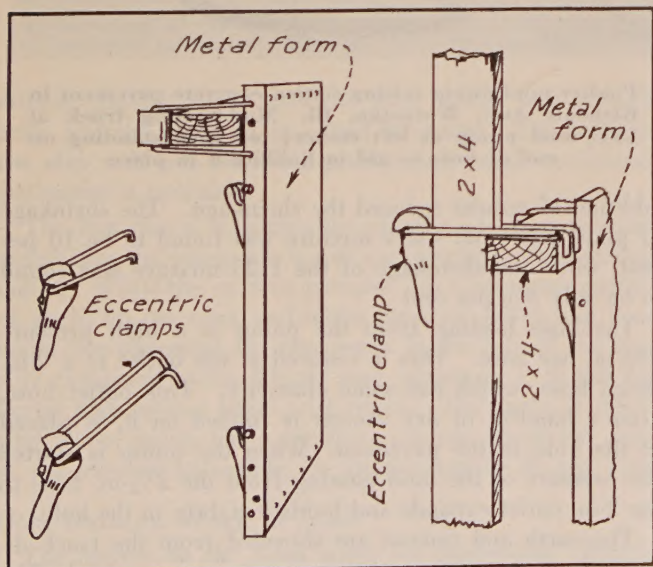


Figure 7. Detail showing 2-by-4 horizontal liner clamped to metal form unit, and vertical liner clamped to horizontal liner

Raising Settled Concrete Pavements With Air-Driven Mud Pump

Equipment Developed on Highway Work in Iowa Being Used on City Streets—Principal Features of Pump

By W. H. ROOT

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PROBABLY the most outstanding recent development in pavement maintenance is the hydraulic pump for raising settled concrete pavements. The engineering profession is familiar with the laws of hydraulic pressure and their various applications to engineering problems. However, it remained for John Poulter, a mechanic of the Iowa State Highway Commission, to apply this hydraulic principle to the raising of pavement slabs. For a considerable period of time he experimented with simple home-made devices for producing hydraulic pressure and applying it to slabs. When he had convinced himself that slabs could actually be raised by hydraulic pressure he developed a machine to produce pressure and applied for a patent on the process.

Principal Features of Mud Pump

From this small beginning has been developed the modern Poulter mud pump for raising pavement slabs. It is a two-cylinder reciprocating pump powered by a 20-h.p. gasoline motor. It is made up of the following principal parts.

- (a) A hopper for receiving earth, water and cement.
- (b) A mixing chamber for mixing the materials.
- (c) A receiving chamber for holding the mud and delivering it to the cylinders.
- (d) The pump itself.
- (e) An outlet hose.
- (f) The power plant.

The actual raising of the slab is a simple process. First a 4-in. expansion joint is cut across the pavement at one end of the settlement. This is done to prevent a binding action when the slab is raised. Next, 2½-in. holes are drilled through the slab, some near the edge and some near the center joint. The holes are spaced from 4 to 10 ft. apart, depending upon the location of the cracks in the slab. This drilling work is done with the ordinary compressed air jack hammer and pavement breaker.

After the slab has been prepared as outlined above the mud pump is put into operation. Earth is brought to the pump in trucks. Black top soil and loess have proven most satisfactory. Sand wears the cylinders too fast, gravelly soil clogs the valves, and heavy clays do not readily form the creamy grout necessary.

Cement Quickens Set and Reduces Shrinkage

Portland cement is added to the earth in the proportion of 1 to 25. The primary reason for adding cement is to cause the grout to set up quickly after it is pumped. This

setting up is not a typical cement set but is an action which produces the same effect as a slight drying out of the mixture. It was early found that under certain conditions the mud pumped in one hole would escape from the other holes or from under the edge of the slab, and no pressure could be built up. It was found that by waiting for an hour or two the mud would stiffen sufficiently so that pumping could be resumed. The addition of 1 part of cement to 25 parts of earth has reduced this waiting time from 1 to 2 hours to from 15 to 20 minutes. Laboratory experiments were carried on, using various proportions of lime, cement and plaster of paris, and the 1 to 25 proportion, using portland cement, was established as the most satisfactory mix. These experiments also showed that the



Poulter mud pump raising settled concrete pavement in Glendale Ave., Winnetka, Ill. Mud-hauling truck at left; mud pump at left center; two men standing on end of hose to aid in holding it in place

addition of cement reduced the shrinkage. The shrinkage of plain earth and water mixture was found to be 10 per cent, while the shrinkage of the 1:25 mixture was found to be only 3½ per cent.

The hose leading from the pump is a high pressure 2½-in. fire hose. This is reduced at the outlet to a 2-in. steam hose, which has some elasticity. This outlet hose, after a handful of dry cement is rubbed on it, is placed in the hole in the pavement. When the pump is started the pressure of the mud passing from the 2½-in. hose to the 2-in. outlet expands and holds it tightly in the hole.

The earth and cement are shoveled from the truck directly into the receiving hopper and water is added. The materials pass from the receiving hopper to the mixing chamber, which resembles the old style continuous con-

Paper read before twenty-third annual meeting of Mississippi Valley Conference of State Highway Departments, Chicago, Ill.

crete mixer. When the material enters the pump it is a soft grout, the moisture content of which is about 45 per cent.

No figures are available as to the exact amount of pressure built up by the pump. The weight of the slab, of course, is only about $\frac{3}{4}$ lb. per square inch, but fairly high pressures are necessary in order to break the slab loose. Once it starts, little pressure is needed to raise it. Some difficulty has been experienced in starting the slabs, but none has been encountered that could not be raised. Some of the older outlet hose has blown out. It is estimated that in some cases a pressure of 50 lb. per sq. in. has been built up.

Operated Five Outfits in Iowa

Iowa has had five mud pumps operating the past season. Some of the slabs which were raised early in the year



Compressed air jack hammer drilling 2½-in. holes in concrete pavement, Glendale Ave., Winnetka, Ill.

settled slightly again and the mud pump was brought back and the slabs again raised to grade. The holes in the slab will not be filled permanently until no further settlement is probable.

The fact that a considerable quantity of water is introduced into the sub-grade is not considered to be a serious matter. While the mud as pumped has a moisture content of about 45 per cent, and while the mud which had been under the pavement for two weeks in the fall of the year still contained about 43 per cent moisture, it is not believed that serious harm will result. The earth as delivered to the pump has a moisture content about the same as the average sub-grade, or approximately 25 per cent.

Cost Data on Work in Iowa

The figures on the Iowa work are interesting. During the 1930 season 200 settlements comprising 9,292 lineal feet, have been raised from 3 in. to a maximum of 13 in. For this work 1,911 cubic yards of earth and 2,299 sacks

of cement were used. Black top to the amount of 899 cu. yd. would have been required to raise the settlements by that method.

The materials for the 1930 work cost \$8,987.29, making a total cost of \$18,896.53 for the 18,584 sq. yd. raised, or a unit cost of \$1.02 per sq. yd. Also, as 1,911 cu. yd. of earth were pumped, the cost was \$9.83 per cu. yd. of material pumped. Of the 1,911 cu. yd. of material used, 899 cu. yd. were required to raise the slab to grade. The remaining 1,012 cu. yd. (53 per cent of the total) went to fill the voids under the pavement.

While this method is slightly more expensive than the black top method (Iowa costs run about 75 cents per sq. yd. for raising with black top), it is so much more permanent that it is believed the extra cost is justified.

Preventing Settlements on Fills

It is anticipated that this method can be extended to prevent settlements. Pavements on fills which are expected to settle can be sounded occasionally and if the soundings show voids under the pavement, these spaces can be pumped full of mud before the pavement settles. Such procedure would result in greater safety to the traveling public and in greater economy to the state.

To Hold International Congress for Testing Materials in Zurich

Copies of Parts A and B of the preliminary reports prepared in connection with the International Congress for Testing Materials to be held in Zürich in the fall of this year, have been issued in printed form and have been distributed to those who held membership in the New International Association for Testing Materials prior to January 1, 1931.

These reports were solicited so that the committee in charge of the arrangement for the International Congress might be guided in the development of the final program. From statements secured from men in the various countries, a number of subjects will be selected for discussion at the Congress. W. H. Fulweiler, the society's representative on the Permanent Committee, secured the statements from the "reporters" in this country.

Reports on cement and concrete scheduled for presentation by engineers from the United States and Canada include the following, all of which belong to Part B:

P. H. Bates, "Some Properties of High Alumina-Cements from Six Countries."

A. T. Goldbeck, "Compression, Tension and Bending Tests, Cement and Concrete."

D. W. Kessler, "The Resistance of Stone to Frost Action."

F. E. Richart, "Stresses and Strains in Spirally Reinforced Columns."

W. A. Slater, "Designing Concrete for High Strength, Low Permeability and Low Shrinkage."

R. B. Young, "Pre-Determination of the Composition of the Concrete Necessary to Attain a Given Compressive Strength."

Part A comprises reports on metals; and when Parts C and D are published the former will cover organic materials and the latter will include questions of general importance.

Estimating Cost of Concrete Work

Figuring Contact Area of Forms—Labor Costs on Various Parts—Quantities of Form Lumber Required—How to Buy Lumber

II—Labor and Material Costs on Form Work

By LESLIE H. ALLEN
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There is a large variation in the quantity of form lumber used by different contractors on similar jobs. Careful contractors, who first study the jobs and design their forms in the office, generally use much less lumber than those who do their thinking and planning on the job as they go along.

Often with a good system of form design a careless foreman may waste a good deal of lumber. A design is not of much value unless the execution of the work is closely watched to see that it is adhered to.—The Author.

MOST of the profit or loss on concrete work is made on the forms. It is most important that the estimator should measure them correctly, and he should distinguish between those parts of the form work which cost more than others.

Forms are measured by the square foot, and every square foot of concrete work that is touched by forms should be measured. The labor on form work varies in proportion to the areas that touch concrete, not in proportion to the lumber purchased for the job.

CONCRETE FORM WORK—QUANTITIES

The estimator should refer to the quantities of concrete that he has already taken, and, following item by item, he should take off forms for each part that will require forming.

Footings and Foundation Walls

Starting with footings, if it is known that the ground will stand without sheeting, or if close sheeting is to be used, form work need not be measured for footings; but if the building has shallow footings, in sand, which it will be cheaper to excavate to a larger area than the base of the footing, forms should be measured for the four sides and multiplied by the height. Example—

Footing forms:

Col. No. 1-6, incl.	32'0" x 2'0"	x No. 6
Col. No. 7, 8	16'8" x 1'10"	x No. 2
Col. No. 9	25'0" x 2'3"	x No. 1

The next form item to be taken will be foundation walls, for which both sides are measured.

Column Forms

Following with columns, take the girth of the four sides or circumference multiplied by the height from floor surface below to the ceiling of the slab above. Example—

Forms, exterior columns:

No. 1-6 incl., 1st floor 8'8" x 12'0" x No. 6

Circular columns and octagonal columns should be measured and priced separately. Brackets and mushroom heads should be enumerated and priced at so much each.

Circular columns and their mushroom heads are usually formed with sheet metal forms; these are generally furnished and erected by special contractors who specialize in such work and quote a unit price of so much each.

Floor Slabs, Beams and Girders

Quantities of forms for floor slabs are the net areas of the ceilings, deducting the areas occupied by beams and girders. It is best to measure first the entire area and then deduct the space occupied by beam bottoms and girder bottoms. Quantities of forms for beams and girders are the net lengths multiplied by the width of the bottom and twice the height from beam bottom to ceiling.

Example—

Forms for floor slabs, 50'0" x 18'0"	900 sq. ft.
Deduct beam bottoms, 18'0" x 1'0" x No. 5	90 sq. ft.

Net area	810 sq. ft.
Forms for beams	350 sq. ft.

Small and Large Openings

It is not usual to deduct forms for small window and door openings and openings in slabs for stairs and elevators. Often it costs more to frame form work around these than to do straight work.

For very large openings, where deductions are taken, an extra item should be measured for forming jambs or slab edges.

The outside edge of the floor slab is equivalent in cost to a beam side and can be grouped with the latter.

Stairs

Forms for stair soffits are measured by the sq. ft. similar to floor slabs; forms for stair risers should be measured

in lin. ft. Forms for window sills and copings are measured in lin. ft.

Tin-Pan Floors

Form work for "tin-pan" concrete floors is usually measured over the ceiling area only, because the metal pans used to form slabs, soffits and sides of ribs are sold by the sq. ft. of floor area. Wood forms for girders are taken in the usual way.

FORM COSTS—LABOR

The labor to be estimated in pricing floor forms will include:

- A—Unloading of the lumber.
- B—Making up panels and jacks, beam sides, column sides, and related work.
- C—Erecting the same.
- D—Stripping (and reshoring floor panels and beams).
- E—Repairing and re-erecting.
- F—Final stripping and removal of material.

MAKING

Forms for footings are sometimes built up in place, but on large jobs it is better to make a schedule of the number and size of form panels required and make them at a bench near the building.

Panels for floor slabs should be handled in the same way. An average cost of 6 cents per sq. ft. should cover the cost of making panels. These panels can be used three or four times, or even more, according to the number of stories in the building and the regularity of its design. In a 4-story building, when forms can be used four times, this would equal $1\frac{1}{2}$ cents per sq. ft. of contact area.

Forms for beam sides and bottoms cost more to make. They are built of heavier stock and are more elaborate in design. A price of 8 cents per sq. ft. should be allowed for them, this figure being divided by the number of times they will be used.

The cost of making jacks and horses is a relatively small item for which a lump sum of \$50 to \$250 can be allowed, according to the size of the job.

ERECTION

Footings

Forms of footings should cost about 20 cents per sq. ft. to erect. Working conditions are usually difficult when footings are being constructed and the cost of forming is high compared with other parts of the work. At the start of the job, also, the carpenter gang is not thoroughly organized, the incompetents have not been weeded out, all of which is reflected in higher unit costs.

Erecting Floor Slab Forms

Forms of floor slabs should be the cheapest item in the form erection. The quantity is much greater than that of footings, columns or beams and large areas can be formed at one operation.

On a building 50 by 200 ft., four stories high, the cost of erecting floor slab forms with their posts, joists and bracing, should not exceed 10 cents per sq. ft. If the paving laid on the ground floor can not be completed before the upper stories are built there will be an extra cost of 3 cents per sq. ft. for laying mud sills on the ground to support the posts and jacks. The above figures

will hold good for regular story heights not exceeding 12 ft. If the building has very high stories the labor costs will increase. A 16-ft. story will cost about 15 per cent more in labor than a 12-ft. story, and a 20-ft. story will cost 25 per cent more.

If the stories vary in height the costs will also be greater. For instance, assuming a building with the following story heights: Basement, 8 ft.; first floor, 12 ft.; second floor, 10 ft. 6 in.; third floor, 11 ft.; fourth floor, 13 ft. Here a good deal of extra expense will be incurred. The panels will be unchanged but the basement posts will be spliced out for the first story (it may be cheaper to buy an entire new set of posts). They will then be shortened for the second story, lengthened for the third and again lengthened for the fourth. Shortening is a simple, inexpensive matter; but for the first, third and fourth stories add at least 2 cents per sq. ft. for the additional labor.

Erection of Beam and Girder Forms

Forms of beams and girders are erected with the floor panels. It is not customary to keep unit costs on them separate from the floor panels. They are, however, a different kind of operation and the cost is greater than that of laying floor panels.

In the preceding figures it is considered that the entire cost of posts and braces is included with the floor panels and the price of erecting beam and girder forms is the cost of placing the sides and bottoms only. These should cost about 16 cents per sq. ft.

On a typical beam and girder floor there is about twice as much panel form area as beam and girder forms, so that the average price for the two would work out as follows:

Erecting 100 sq. ft. panel forms at 10 cents.....	\$10.00
Erecting 50 sq. ft. beam and girder forms at 16 cents	8.00

Total cost of 150 sq. ft. \$18.00

Average cost per sq. ft., 12 cents.

If the floor design varies from floor to floor, owing to change in location of openings or in the floor loads, beams and panels will have to be remade on each floor. The cost of this will depend on the amount of changes to be made. Under normal conditions it should not be less than 2 cents or more than 5 cents per sq. ft.

Tin-Pan Floor Construction

Metal forms for "tin-pan" construction are leased from the manufacturers, who will quote a price for each job based on its individual requirements. The price is based on the quantity of metal pans to be delivered to the job (usually enough for one floor) plus an additional charge for the number of re-uses required. When the concrete work is finished, the metal pans have to be shipped back to the manufacturer by the contractor.

On a 5-story building, in which one set of metal forms would be used five times, the manufacturer's charge will be about 3 cents per sq. ft. on the entire floor area of metal pan construction. A 4-story building would cost about $3\frac{1}{2}$ cents per sq. ft. and on a one-story building, where pans were only used once, the charge may run as high as 10 cents per sq. ft.

The form labor involved will consist of erecting posts,

jacks, ledgers and rib bottoms, which will cost about 7 cents per sq. ft. plus 2 cents per sq. ft. for placing metal pans. Total, 9 cents, not including stripping.

Wood forms for girders will be priced on the same basis as ordinary wood girder and beam forms.

Column Form Erection

Erection of plain rectangular column forms, not less than 18 or more than 36 in. square, should cost about 15 cents per sq. ft. Forms for small columns, 12 or 15 in. square, cost more, as there is just as much labor required in erecting, plumbing and bolting up, as in columns of twice the width. These should cost 25 cents per sq. ft.

Very large columns are often required on the corners of a building, in widths up to 5 ft. There is a good deal of extra expense in these, as the form panels are so large and unwieldy that a larger gang is required to handle them. They can not be priced at less than 20 cents per sq. ft. Very short columns also cost more per square foot than tall ones, as the plumbing costs are just as high.

Columns of irregular shape will cost from 20 to 50 per cent more to erect than rectangular columns.

Wall Forms

Wall forms will cost from 15 to 20 cents per sq. ft. Although wall forms look like simple work, experience shows that the difficulty of keeping them exactly plumb throughout their length is considerable and the cost is higher accordingly.

STRIPPING COSTS

Stripping costs are fairly uniform throughout the job. The stripping operation consists of unbolting and removing forms from the concrete and moving the forms to the next place or story where they are to be used (or to the lumber pile or truck when the job is finished). Costs vary according to union conditions. In some cities local agreements provide that all stripping shall be done by carpenters, in others by laborers, or by a gang of one carpenter and two or three laborers.

Where carpenters only are used, stripping costs may run as high as 3 cents per sq. ft. Laborers alone can do it for 1½ cents.

Sills, Copings and Stairs

Forms for window sills and copings cast in place should cost about 30 cents per lin. ft. of sill to make, erect and strip.

Forms for stair soffits should cost 30 cents per sq. ft. to make, erect and strip.

Forms for stair risers should cost 25 cents per lin. ft. to make, erect and strip.

EXAMPLE OF ESTIMATE ON FORM LABOR FOR 4-STORY CONCRETE BUILDING 50 BY 200 FT.

Footings, 5,000 sq. ft.		
Make 2,500 sq. ft. @ \$0.06		\$ 150
Erect 5,000 sq. ft. @ .20		1,000
Strip 5,000 sq. ft. @ .01½		75

Total cost, 24 cents per sq. ft. \$1,225

Floors and beams, 50,000 sq. ft.		
Make slab forms, 9,000 sq. ft. @ \$0.06		\$ 540
Make beam forms, 4,000 sq. ft. @ .08		320
Make posts and jacks		75
Erect slab forms, 35,000 sq. ft. @ .10		3,500
Erect beam forms, 15,000 sq. ft. @ .16		2,400
Strip 50,000 sq. ft. @ .02		1,000

Total cost, 15⅔ cents per sq. ft. \$7,835

Columns: 8,000 sq. ft. exterior, 7,000 sq. ft. interior.
Total, 15,000 sq. ft.

Make exterior 2,600 sq. ft.

Make interior 2,000 sq. ft.

	4,600 sq. ft. @ \$0.08	\$ 368
Erect	15,000 sq. ft. @ .16	2,400
Strip	15,000 sq. ft. @ .02	300

Total cost, 20 cents per sq. ft. \$3,068

Stairs (two flights), soffits 1,000 sq. ft. Risers 800 lin. ft.

Make soffits, 600 sq. ft. @ \$0.08	\$ 48
Make risers, 800 lin. ft. @ .05	40
Erect soffits, 1,000 sq. ft. @ .20	200
Erect risers, 800 lin. ft. @ .20	160
Strip	50

Total \$498

Window sills and copings 1,800 lin. ft.

Make, erect and strip, @ \$0.30 \$540

FORMS—MATERIAL

When the estimate for form lumber is being made, form designs for the job are never available. The estimator has to fall back on past records of similar jobs.

A good rough rule for average jobs is that 4 bd. ft. of lumber are required for each sq. ft. of surface contact, divided by the number of uses contemplated.

Closer estimating shows that some parts of the work require less or more than this.

The writer's own rules for general use are:

Footings and foundations, 3 bd. ft. per sq. ft., divided by the probable number of uses.

Floors and beams, 4 bd. ft. per sq. ft., divided by the number of stories.

(Continued on Page 24)

EXAMPLE OF ESTIMATE OF FORM LUMBER REQUIRED

Contact area of footings,	5,000 sq. ft. × 3 = 15,000 ÷ 2 uses = 7,500 bd. ft.
Contact area of floors and beams, 50,000 sq. ft. × 4 = 200,000 ÷ 4 uses = 50,000 bd. ft.	
Contact area of external columns, 8,000 sq. ft. × 3 = 24,000 ÷ 3 uses = 8,000 bd. ft.	
Contact area of internal columns, 7,000 sq. ft. × 3 = 21,000 ÷ 4 uses = 5,250 bd. ft.	
Contact area of miscellaneous, 4,000 sq. ft. × 4 = 16,000 ÷ 2 uses = 8,000 bd. ft.	

Total contact area 74,000 sq. ft. Total lumber required 78,750 bd. ft.

Test Aerocrete Floor Construction

Official Committee of Engineers Representing City of Chicago Supervises Tests—To Draw Up Official Regulations Governing New Type—Earlier Tests in New York

The light-weight floor construction here described is a form of composite construction for which design practice has been under development for several years.

Essential features of the test methods and results, and recommendations of the committee of structural engineers concerning design practice, will be covered in later issues of "Concrete."—The Editors.

LOAD tests of a composite type of aerocrete and steel beam floor construction, conducted under the supervision of a committee of structural engineers appointed by the building commissioner of Chicago as the official representatives of the city building inspection department, should have results of far-reaching importance. The purpose of the Chicago tests was that of obtaining data which would serve as a guide for drawing up official regulations governing the use of this form of construction within the city.

Previous Tests in New York

Three previous tests of aerocrete in building construction have recently been conducted in New York under the supervision of the Bureau of Buildings, Borough of Manhattan, and in the presence of an official representative of the bureau.

Partition Block Tests. The first of the three New York tests to which reference has just been made was a fire and water test conducted on May 17, 1928, at the Columbia University testing station at Greenpoint, L. I., to determine the fireproofing value of aerocrete partition blocks. The test resulted in the official approval of 2½-in. aerocrete blocks, with ⅝-in. plaster on the exposed side, as fireproof partition construction.¹

Fireproof Floor Construction. The second of the New York tests was a fire test conducted on January 3, 1929, at Columbia University fire testing station, to determine the fireproof qualities of two types of floor construction, designated as Type I and Type II.

The first (Type I) was ribbed slab construction consisting of reinforced stone concrete ribs 20 in. on centers,

¹The official approval is contained in Bulletin No. 14-1928, dated July 18, 1928, of the Bureau of Buildings, Borough of Manhattan.

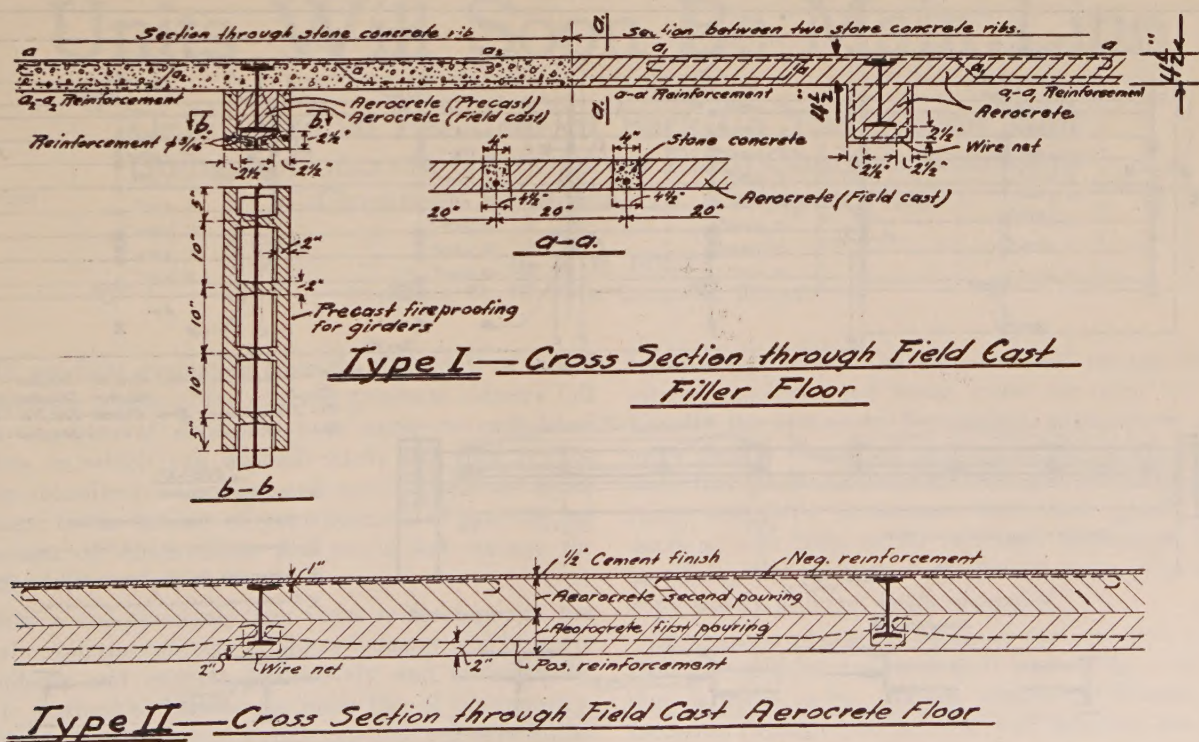


Figure 1. Details of aerocrete floor panels for test of fireproof floor construction, approved by New York Bureau of Buildings

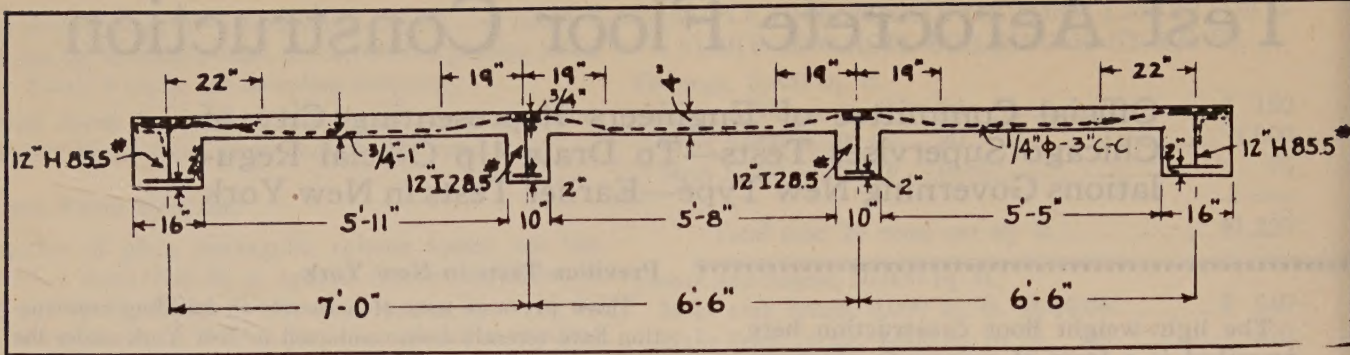


Figure 2. Details of aerocrete structural floor construction, approved after tests by New York Bureau of Buildings

a top width of 4 in., a bottom width of $4\frac{1}{2}$ in. and a depth of $4\frac{1}{2}$ in., the space between ribs being filled with aerocrete. This construction is shown in the upper part of Figure 1.

Type II construction, shown in the lower part of Figure 1, consisted of a poured-in-place aerocrete slab $10\frac{1}{2}$ in. thick with a $\frac{1}{2}$ -in. portland cement mortar finish on top. The slab was deposited in two layers.

In both Type I and II construction the supporting girders were protected with poured-in-place aerocrete.

Official approval was granted to both types for spans up to 8 ft. between supporting beams, and for uniformly distributed live loads up to 150 lb. per sq. ft.²

In both the first and second of the New York tests just described, aerocrete was shown to be one of the most fire-resistive building materials. In this respect the results were in line with results developed in fire and water tests

made at Columbia University in 1927, and in heat insulation tests made at Armour Institute in 1929.³

Structural Floor Construction. The third New York test was to some extent comparable to the tests recently completed in Chicago, for it involved a load test on a continuous type of structural floor construction shown in Figure 2. This construction, as the drawing indicates, consisted of continuous spans of aerocrete slabs 4 in. thick, weighing 59 lb. per cu. ft., and reinforced with welded wire fabric having longitudinal wires $\frac{1}{4}$ in. in diameter spaced 3 in. center to center. The reinforcement was continuous over intermediate supports and bent over the beam flanges at the outer sides of the end spans.

Official approval was granted for spans not exceeding 7 ft. center to center of supports, and for a uniformly distributed live load not exceeding 150 lb. per sq. ft.⁴

²Reported in 1930 Guide of the American Society of Heating and Ventilating Engineers.

⁴Official approval is contained in Bulletin No. 16-1929, dated December 5, 1929, of the Bureau of Buildings, Borough of Manhattan.

²The official approval is contained in Bulletin No. 5-1929, dated April 2, 1929, of the Bureau of Buildings, Borough of Manhattan.

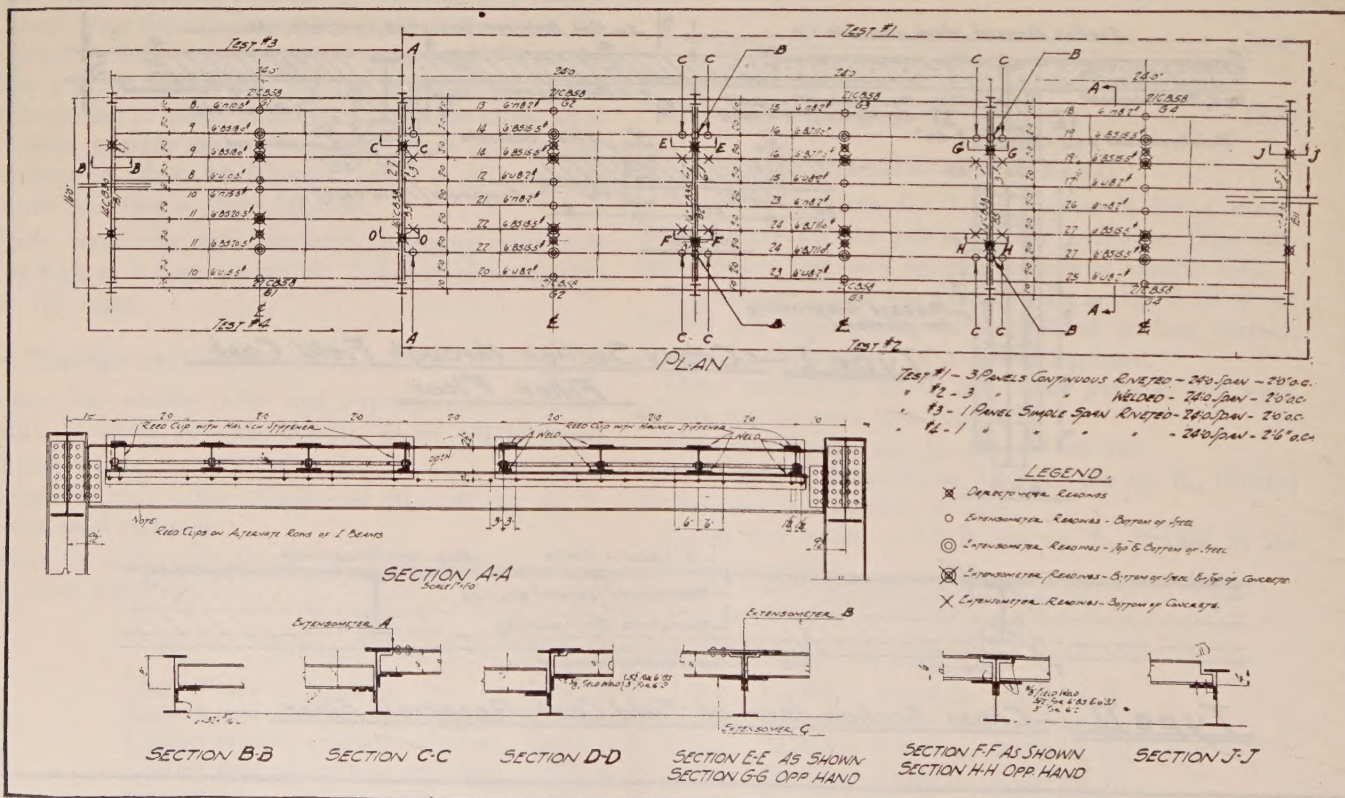


Figure 3. Details of aerocrete I-beam flat floor construction, tested in Chicago to provide data for approved design practice

Chicago Type Has Improved Details

The test panels built for the tests in Chicago, conducted at Orleans St. and Carroll Ave. from January 6 to 12, 1931, were designed with the view of getting better continuity of the steel members themselves. As shown in Figure 3, the steel frame for the Chicago tests consisted of four bays, each 16 by 24 ft., with 6-in. I-beams or channels spanning the 24-ft. length and spaced, for the most part, 2 ft. center to center. The manner in which the continuity of the steel beams was obtained across the supports is indicated in the various sectional views in Figure 3.

It is interesting to observe that welded connections were employed in erecting a part of the steel beams.

Aerocrete Placed in Two Layers

As in Type II of the second New York test, the aerocrete slab which embedded the steel beams and channels was placed in two layers, to a total thickness of about 9½ in. The bottom layer was placed to a depth of 3 to 3¼ in. and expanded to about 6¼ in. The second layer was placed to a depth of 1¾ to 2 in. and expanded to about 3¼ in. Samples cut from the slab after the test was completed disclosed that the weight of the aerocrete was 55 lb. per cu. ft. The proportions for the two layers of aerocrete are given in Table 1.

TABLE I

Proportions for Layers of Aerocrete in Chicago Test Panels

Material	Quantities per batch in ½-yd. mixer	
	Bottom Layer	Top Layer
Portland cement	3 sacks	3 sacks
Sand	300 lb.	540 lb.
Lime	15 lb.	15 lb.
Water	24 gal.	27 gal.
Aerocrete compound	2 lb.	4 lb.

Weight of Floor Construction

The floor finish of ordinary cement-and-sand mortar was 1 in. thick and weighed 12 lb. per sq. ft. The average weight of the steel beams was 7.3 lb. per sq. ft., so that the actual weight of the floor construction, including the 9½-in. thickness of aerocrete, the cement mortar finish and the steel beams, was about 62 lb. per sq. ft.

Acknowledgments

The committee of structural engineers appointed as official representatives of the city of Chicago included Frank E. Brown, Magnus Gunderson and Frank A. Randall. The actual conduct of the Chicago tests and tabulation of test records were in the hands of the Robert W. Hunt Company, of Chicago, and the tests were sponsored by the Aerocrete Western Corporation, of Chicago.



Predicts Light-Weight Concrete Units Will Soon Be Main Line

Only 15 to 20 Per Cent of Back-Up Tile Market Now Going to Concrete Units—Few Plant Changes Necessary—Greatest Essential Is Ability to Sell

By H. H. POTTS
President, H. H. Potts Company, Chicago, Ill.

THE products emanating from the thousands of manufacturing plants of the concrete products industry fall within two general divisions—your main or established products on which you depend chiefly for your profits, and the subsidiary, secondary and special products which contribute to the success of your business in general, but on account of which alone you would not attempt the operation of your plant.

Within a comparatively few years a development has come about in the concrete products industry which nearly all students and experts, collectively and individually, agree is destined to become the main line of the industry. I refer specifically to light-weight concrete masonry building units, adapted to and primarily used in back-wall construction above grade in practically all types of structures.

There are few mechanical requisites for manufacturing light-weight units that are not also required for ordinary

heavy-weight units. The same standard storage facilities, mixers, machines and steam rooms are used for either. Usually the change to light-weight units means nothing more than a change of aggregates; therefore, it would seem that products manufacturers are offered an opportunity materially to increase their total volume of production, with little or no increased investment, without sacrificing the products they already make. The two occupy widely different fields of market.

In concrete plants the overhead cost per unit is higher than it should be, and, as I shall try to show, it is higher than it needs to be. Having whatever maximum manufacturing capacity you possess, your problem can hardly be solved through a reduction in your present capital investment. But it is susceptible of salvation through building up the volume, at least to the point where a satisfactory and safe cost per unit results.

Light-Weight Units Offer Opportunity

It must be very doubtful if any marked increase in total volume of ordinary concrete blocks will come about in the next few years; hence, the manufacture of light-weight units offers the chief hope, and a genuine opportunity for building up production. Even the production records of the past three years show a marked increase in the use of light-weight units, notwithstanding the late unfavorable building times, and a marked decrease in the use of ordinary heavy-weight units.

The real job comes in selling. In these competitive times, no product sells itself. Light-weight units must be sold, and even possessing the qualities they do, the task is not always easy.

Sell Aggressively

Courage to assume the larger task comes from the knowledge that light-weight units by the millions are being sold; that they are susceptible of sale and use in almost every type of building; in the knowledge that the market is quite unlimited, and in the further knowledge that the quality product made contributes much to the better character of structures in which they are used. In your town there may be a school building, or a church, or a hospital; or in some other town in your county or state stands a warehouse, a manufacturing plant or some other structure of equal importance that constitutes a monument to the industry. So with the basic knowledge and belief that the product you are selling is one for which you need make no apology, you undertake the job of selling it with an aggressiveness that will gain the results for which you hope.

It would be quite useless to undertake the manufacture of light-weight units, unless the manufacturer is prepared and determined to assume the effort necessary to make the work successful. If he is prepared, or cares to prepare himself for this not impossible task, he can make of his business, in this department, within a reasonably short length of time, just about what he cares to make of it.

The entire concrete products industry is getting only from 15 to 20 per cent of the volume available where light-weight units might well be used. As you make inroads on the remaining 80 to 85 per cent, you are contributing to that extent to the sound growth of your own business, and as a link in a great chain, contributing to that extent to the upbuilding of the entire concrete products industry.

The general quality of light-weight units is no longer questionable or experimental. In age comparison with many forms and types of building materials, they are new. But the research work has been done, the proof of quality through service, age and experience is definite. They have been tried and not found wanting in any of the essential requirements. Structurally they conform to building code requirements. There is plenty of proof that they offer the architect, the builder or the owner advanced qualities in insulation, sound-absorption and fire resistance, coupled with economies through nailing, laying, direct plastering, cutting and other tangible and intangible features.

It is the author's opinion that the fact of their being a locally manufactured product should be stressed. After all, the buildings constructed in your community are local to your community. You are a taxpayer. You employ labor. You contribute to the maintenance of government and the existence of your community. Why then should materials from a more distant territory be imported into your community when you have one to offer, less expensive in the wall and still superior? Especially should this deserve consideration for public buildings, constructed and paid for by your own money and that of your neighbor. The pleading of this theory takes no aspect identified with the use of a "club." It is sound economically and ought to be presented.

The variety of light-weight aggregates of proved merit is limited, yet the quantity and quality is abundant for the major central states manufacturing plants. The distribution by the aggregates producers is pretty well controlled, wisely I believe, in the interest of minimum competition in price among concrete products manufacturers.

The operation of a plant for light-weight units of a certain type in any community need not be discouraging to another plant contemplating a similar business with another light-weight aggregate. What the light-weight aggregate industry is doing is creating a demand for light-weight units. The type of aggregate used is secondary, provided it possesses the required qualities. Every plant making light-weight units can and does contribute to the advancement of the whole idea. You still have 80 to 85 per cent of the building construction to work on, and you should not spend your time heralding knocks of your neighbor's product. We need business tolerance in the concrete products industry, just as it is needed everywhere else. Make a good product and sell it on an ethical basis.

The work of erecting buildings will go on. Building materials, structural and otherwise, will always be needed. If you can make as good a product as is being used, and sell it because it is economical and has quality, your business ought to grow. Every piece of competing building material that is used in your town was sold by some one. Was your plant suffering from under-production while those sales were taking place? It means some work to sell; but after all, that's what you went in business for.

Expects Rapid Growth in Next Five Years

To sum it all up, the demand for light-weight units will grow, and grow rapidly; the greatest percentage of growth will come in the next five years. Progressive concrete products manufacturers are going to make these units in vast quantities, and their plants will become outstanding manufacturing institutions in their respective cities. These products are going to be looked upon with increasing favor by architects, builders, contractors, owners and all others whose duties require the passing of judgment. The ultimate hope of all business will come about in these plants—namely, their volume of business will increase so materially that gross revenue will increase, lower unit production costs will follow, and then net profit will appear. Failing to take advantage of these opportunities will leave one manufacturer in a position of disadvantage compared with those who take action.

Condensed from paper read at the joint annual meeting of the Concrete Masonry Association and the Wisconsin Concrete Products Association, Milwaukee, Wis., February 23-24, 1931.

Cement, Concrete and Concrete Units Fill A. S. T. M. Sessions

Thirty-Fourth Annual Meeting Gives Exceptional Attention to Hollow Concrete Units—Wall Stability and Fire Tests Reported—Concrete and Admixture Draw Discussions

THE American Society for Testing Materials is holding its thirty-fourth annual meeting at the Stevens Hotel, in Chicago, from June 22 to 26, the greater part of the sessions on concrete and concrete units falling on the last day of the meeting, as the July issue of CONCRETE goes to press.

Weathering of Concrete and Aggregates

As noted on page 39 in the June issue of CONCRETE, the morning session of Thursday, June 25, included a symposium on the weathering characteristics of masonry materials. During this session the weathering of concrete was discussed by E. Viens,¹ and the weathering of aggregates by L. O. Hanson.²

The use of specifications, as also mentioned in the June issue, page 39, was discussed from the standpoint of the producer of concrete, by J. P. H. Perry;³ and from the viewpoint of the user of concrete, by Arthur R. Lord.⁴

Paper on Admixtures in Concrete

A paper, entitled "Crystalline Talc as an Admixture in Concrete," presented by F. R. Wicks, discussed results obtained in concrete by the use of crystalline talc admixture, in both laboratory and field work extending over a period of five or six years. An interesting phase of this paper is the discussion of the relationship between various admixtures and the water-cement ratio law.

Concrete and Concrete Aggregates

The 128-page report of Committee C-9 on Concrete and Concrete Aggregates, presented by Cloyd M. Chapman,⁵ was in itself a fair indication of the vast scope of the work of this committee that was accomplished during the past year. The committee submitted for publication as tentative the following five new specifications and three new methods of test:

- (1) Specifications for Curing Portland Cement Concrete.
- (2) Specifications for Curing Portland Cement Concrete Slabs with Bituminous Coverings.
- (3) Specifications for Curing Portland Cement Concrete Slabs with Calcium Chloride Admixture.
- (4) Specifications for Curing Portland Cement

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²Instructor, Engineering School, University of Wisconsin, Madison, Wis.

³Vice-President, Turner Construction Co., Chicago, Ill.

⁴Consulting Engineer, Chicago, Ill.

⁵Consulting Engineer, New York, N. Y.

Concrete Slabs by Surface Application of Calcium Chloride.

(5) Specifications for Curing Portland Cement Concrete Slabs with Wet Coverings.

(6) Method of Test for Structural Strength of Fine Aggregate, Using Constant Water-Cement Ratio Mortar.

(7) Method of Test for Apparent Specific Gravity of Coarse Aggregates in a Saturated Condition.

(8) Method of Routine Analysis of the Cement Content of Portland Cement Concrete.

Committee C-9 also recommended that the Tentative Specifications for Concrete Aggregates (C 33-30 T) be revised and continued as tentative. The proposed revisions include various changes in the wording of specifications for fine and coarse aggregates, the inclusion of a clause on uniformity, a statement covering gradation with reference to percentages of various sizes, and a requirement for the use of the water-cement ratio strength test.

High-Early-Strength Cement

Committee C-1 on Cement has effected a complete reorganization during the year, and various subcommittees have been engaged in the problems assigned to them. Subcommittee C on High-Early-Strength Cement reported having received but few comments regarding the Tentative Specification for High-Early-Strength Portland Cement (C 74-30 T). The few comments received indicate that the 24-hour strength requirement may be too high; but not enough discussion has been sent in to supply the basis for a decision. In consequence, the tentative standard C 74-30 T is recommended to be continued in its present status.

Masonry Cement

Subcommittee D of Committee C-1 on Cement has prosecuted its study of masonry cements, a problem involving considerable difficulty because of the wide divergence of chemical composition and other properties found in the various cements coming under this classification.

The subcommittee reports a surprisingly large increase in the use of masonry cements during the past few years.

Concrete Masonry Units

Never before in the history of the American Society for Testing Materials has so much time and prominence been given to hollow concrete masonry units as during this meeting.

Specifications and Tests. To begin with, D. E. Parsons,⁶

⁶Chief, masonry construction section, U. S. Bureau of Standards, Washington, D. C.

chairman of Committee C-10 on Hollow Masonry Building Units, presented the report of the subcommittee on concrete building units, covering Specifications and Tests for Load-Bearing Concrete Masonry Units.

Fire Resistance. A 54-page paper entitled "Tests of the Fire Resistance and Stability of Walls of Concrete Masonry Units" was presented by C. A. Menzel.⁷ This paper includes the principal results thus far obtained in a comprehensive and systematic investigation of the fire-resistant and load-carrying properties of approximately 100 walls of concrete masonry units when subjected to standard fire endurance and load tests. The tests covered studies of the relative influence of such factors as type and grading of aggregate, cement content, design of unit, type of mortar, workmanship, and application of plaster.

With the exception of size of wall, the tests were conducted strictly in accordance with Standard Specifications for Fire Tests of Building Construction and Materials. Both because of limitations in the space available for the test equipment and the excessive cost in a series of tests of this magnitude, walls about 5½ ft. wide and 6 ft. high with a total area of about 33 sq. ft. were employed instead of walls 9 ft. in height and 100 sq. ft. in area required by these specifications. To compensate for the reduction in size of the test walls as well as to improve the precision with which such tests are usually conducted, a particularly rigid test technique was adopted. It is believed that the technique followed gives a reliable basis for comparison of the relative fire-resistant properties of the walls and of the relative influence of the various factors studied.

Wall Stability Tests. A paper of unusual interest was presented under the title of "Tests of the Stability of Concrete Masonry Walls" by F. E. Richart,⁸ P. M. Woodworth⁹ and R. B. B. Moorman.¹⁰ The tests described were conducted at the University of Illinois under a co-operative agreement between the university and the Concrete Masonry Association.

The test program included tests on 60 walls of hollow concrete masonry building units, 6 ft. long and 9 ft. 6 in. high; 42 wallettes, or small walls, 32 in. long and 4 ft. high, and accompanying tests of building units and materials. The walls were tested in compression, axial and eccentric, and in flexure. From the results of the tests, several fairly definite relations were established. The compressive strength of large walls was shown to be quite closely dependent upon the compressive strength of the units used therein, and the average ratio of strength of wall to that of unit was found to be 0.53. The ratio of compressive strengths of large and small walls was found to be fairly constant, with an average value of 0.91. This would seem to establish the propriety of using wattle tests as indicative of the strength of wall construction, using the reduction factor found. Eight-inch walls with face-shell mortar beds were found to have four-fifths of the compressive strength of similar walls with full mortar beds. The effect of other variables included in the in-

vestigation, such as type of aggregate, strength of mortar and thickness of walls was found to be less definite. Composite walls of face brick and concrete units showed satisfactory behavior and strength.

Freezing and Thawing Tests

Among other papers having special value to the concrete construction industry was one by F. C. Lang¹¹ and C. A. Hughes¹² entitled "Accelerated Freezing and Thawing as a Quality Test for Concrete Aggregates." This paper described the methods employed in testing the influence of various freezing and thawing cycles on stones of different structure, such as sandstone and limestone; the effects of freezing and thawing at 10, 20 and 30 cycles, on 30 representative coarse aggregates produced in Minnesota; and the freezing and thawing of 3 by 6-in. concrete specimens made from the tested aggregate.

Effect of Coarse Aggregate Content

An interesting paper entitled "Relation of Coarse Aggregate Content to the Quality of Paving Concrete" was presented by F. H. Jackson¹³ and W. F. Kellermann.¹⁴ This paper comprises a report on tests made on a 9-ft. concrete pavement approximately half a mile long, built for the purpose of studying the effect of increasing the amount of coarse aggregate considerably beyond the amount commonly used.

Centrally-Mixed Concrete

W. A. Slater¹⁵ presented a paper under the title of "Tests of Concrete Conveyed from a Central Mixing Plant." His paper comprised a report of tests made to determine the effect of time of haul on strength of transported concrete. The tests were made by charging a drum of 2 cu. yd. capacity with concrete and transporting it over city streets for 2½ hours. Samples of the concrete were taken at intervals varying from 15 to 30 min. Compressive strength specimens were made from these samples, and these specimens were tested at ages of 1, 2, 4, 7, 14 and 28 days. Other portions of the samples taken were analyzed, and these analyses are given in the paper.

¹¹Engineer of Tests and Inspection, Minnesota Department of Highways, St. Paul, Minn.

¹²Assistant Professor of Structural Engineering, University of Minnesota, Minneapolis, Minn.

¹³Senior Engineer of Tests, U. S. Bureau of Public Roads, Washington, D. C.

¹⁴Assistant Materials Engineer, U. S. Bureau of Public Roads, Washington, D. C.

¹⁵Director, Fritz Engineering Laboratory, Lehigh University, Bethlehem, Pa.

Coming Conventions

August 25-26—National Ready Mixed Concrete Association, second annual convention. William Penn Hotel, Pittsburgh, Pa.

October 12-16—National Safety Council, 20th Annual Safety Congress and Exposition. Chicago, Illinois.

January 9-15—American Road Builders Association, twenty-ninth annual convention and road show. Detroit Airport Building, Detroit, Mich.

⁷Associate Engineer, research laboratory of the Portland Cement Association, Chicago, Ill.

⁸Research Associate Professor, theoretical and applied mechanics, University of Illinois.

⁹Associate Engineer, Portland Cement Association, Chicago, Ill.

¹⁰Special Research Assistant, theoretical and applied mechanics, University of Illinois.

Build Intake and Discharge Tunnels for Large Generating Plant

Placing Concrete in Winter—Siliceous Admixture Improves Strength and Flowability—Copper Strips Make Water-Tight Construction Joints—Engineering Inspection Work Praised

By CHARLES C. MOODY

Engineer, Herlihy Mid-Continent Company, General Contractors, Chicago, Ill.

The first part of this article, on the problems in excavating, the plant arrangement and the concrete distributing system, was published beginning on Page 17 of the May issue of "Concrete."

This second part describes the concrete placing, use of admixture, and other features.—The Editors.

WHEN excavation was started on the electric generating plant for the Chicago District Electric Generating Corporation, under construction on made land jutting into Lake Michigan near the Indiana-Illinois state line, the work was arranged so that some of the excavated material could be placed directly into the backfill.

It was decided that when a portion was dug to the required depths to drive piles immediately and follow with form work and concrete. In this way backfilling could be done with the material being taken out, which otherwise would be wasted outside the building lines and eventually have to be hauled back.

Two gasoline-driven cranes, swinging clamshell buckets from their long booms, were continually in motion during this process. In this way, a considerable saving was made in the hauling away of excavated materials.

Because of the constant movement of these cranes it was impossible to put in the permanent runways as originally planned. Instead, short lengths of runways were used for the concrete work and then taken down after that particular section of the job had been concreted.

Discharge and Intake Tunnels Are One Structure

The intake and discharge water tunnels are really one tunnel of concrete, but divided in the center with a horizontal partition. The bottom of the lower tunnel was at a grade of approximately -26, or about 30 feet below grade. This entailed the excavating of about 12 ft. below clay level.¹ It also meant the use of wood sheathing to act as a cofferdam through the sand below the grade of general excavations. For this purpose, 3-in. tongue-and-grooved wood sheathing was jetted into place, and driven into the clay with compressed air jack hammers. As the inside was excavated with a clamshell, the sheathing was

gradually driven down, and 6 by 8-in. walers were put in place and braced across with timbers of the same size.

Piles were cut off at the proper elevations, reinforcing rods placed in the bottom and along sides, and form work carried up to the bottom set of walers. Then the concrete bottom was placed, and a short portion of the walls.

The form work was well braced across the tunnel, which enabled the removal of the first set of timbers. Form work was again carried up ready for another run of concreting, and the same operation repeated until finally the entire tunnel was concreted.

It was remarkable how little seepage came into the excavation of this tunnel, although only about 50 ft. in length was opened up at any one time. Even so, the system used in enclosing the entire job, and the care with which it was accomplished, facilitated the tunnel work.

Placing Concrete in Winter

There has been much said in the past, both pro and con, about carrying on construction work during the win-



Figure 6. By following excavating work closely with concreting operations, cranes with long booms were able to place excavated material into the backfill direct

ter months, and in climates where weather is a serious obstacle.

An example of concrete construction, the bulk of which was carried out after November 1st, 1930, may be seen in the State Line job.

¹See Figure 2, in May issue of CONCRETE, page 18.

In his thirty years of experience, the writer has never seen any better concrete than was placed into the forms on this work. True, the weather last winter was not unusually severe, but there were many days when the aggregate had to be heated along with the water used in concreting, and the finished work covered to protect it from freezing; and from about November 1, 1930, to shortly after January 1, 1931, nearly 20,000 cu. yd. of concrete had been placed.

A steam pipe led into the material hopper for warming the aggregate, and water was heated to 100 deg. F. for concrete mixing. From the time the concrete left the mixer until it was deposited in the forms, there was not a loss of more than 20 deg. F. in the temperature.

After forms were filled, they were immediately covered with loose hay for protection against freezing. Many tests were taken with a thermometer, and 12 hours following a run of 500 cu. yd. it was found that the concrete temperature was 42 deg. F. when the outside temperature had been around 5 deg. above zero all during the 12-hour period.

In some instances where walls were concreted, especially in the tunnel sections, salamanders had to be placed under canvas protection, but these cases were few in comparison with the numerous runs of concreting that did not require them.

Siliceous Admixture Improves Concrete

Doubtless some of the credit for the good appearance and workability of the concrete, and the watertightness obtained, was due to the use of an admixture containing 97½ per cent of silica. Through the use of the admixture a marked increase in flowability was obtained, along with a higher degree of uniformity and greater strength than before the admixture was employed. The 28-day strength of test cylinders, in fact, was increased from an average of about 2,900 lb. per sq. in. to an average of about 4,000 lb.

Construction Joints Made Watertight

Due to the excess of water under the basement floors, some arrangement had to be made to insure against leakage at construction joints. The joints between runs of concrete meant a crack, and eventually a leak, unless a watertight joint was made. A watertight joint was insured by the use of a 12-in. copper strip, which was bent lengthwise at right angles in the center and nailed to a beveled 2 by 4-in. strip. This strip was tacked to the bulkhead, allowing the copper to project into the soft concrete. After the forms were stripped from this run of concrete, the copper was bent out at right angles to the bulkhead and the beveled strip removed. This piece of copper, therefore, projected into the concrete 6 in. on each side of the joint and prevented leakage. This method was used not only for slabs on the ground, but also for walls below grade.

Engineering Inspection Work of High Order

All work done at State Line is under rigid inspection. The generating company maintains its own construction bureau and its staff of engineers. The designing engineers have a representative on the job at all times. The architects have a representative on the job to see that all materials and workmanship conform to specifications.

The generating company's engineers, therefore, are

placed there to assist the contractor in every way. If it is possible for them to suggest methods whereby the contractor can save money in his operations, this is done.

This attitude on the part of the generating company's engineering inspection forces has created harmony between the owners and contractors on construction work in general. It also gives the owner a better job in the long run.

Estimating Cost of Concrete Work

(Continued from Page 16)

Columns, 3 bd. ft. per sq. ft., divided by the number of stories.

Walls, 3 bd. ft. per sq. ft., divided by the probable number of uses.

The cost of form lumber will depend on the local market. A good figure at the present time would be \$35 per M for the roofers and \$45 per M for the dressed stock. \$42 per M would be a fair average.

It is always worth while to make a careful quantity schedule of form lumber when the forms are designed and to buy as much as possible from mill delivery. Contractors should only buy enough lumber from stock to get the footings and basement walls started. This will make a good saving in the cost of the lumber.

It is false economy to buy the cheapest and poorest grades of lumber available, as when poor lumber is used the surfaces of the finished concrete are very rough and show a large amount of "fins." Where a good appearance is required the cost of removing fins and repairing the surface is likely to be more than the amount saved in the price of lumber.

In estimating the quantity of lumber required the speed of the job must be taken into account. A 4-story building can be built at the rate of two weeks per story in summer with one complete set of forms for the first story, which is re-used on each upper story. If the job must be built at the rate of one story a week, two complete floors of forms will be required. This will double the quantity of lumber required for floor forms and also double the making costs (erection and stripping costs will not be changed). In cold weather it is also necessary to provide extra lumber for reshoring floor panels after stripping.

* * *

(The next installment, in the August issue of CONCRETE, will deal with the handling of steel reinforcement, and with finishing costs.)

In the Technical Society Journals

Design of Wind Bracing. The entire issue of the November (1930) Journal of the Boston Society of Civil Engineers, 715 Tremont Temple, Boston, is occupied by a paper on "Design of Wind Bracing," by Edward Smulski. Both reinforced concrete and structural steel frames are considered; though because of the comparative simplicity of providing wind bracing in reinforced concrete frames, the greater part of the text is devoted to structural steel buildings. Design formulas are given.

EDITORIAL

The Progressive Two Hundred

THE manner in which the concrete products industry has supported the Concrete Masonry Association in the problem of financing the wall stability tests at the University of Illinois, just reported to the American Society for Testing Materials, is a gratifying indication that life is flowing in the veins of this industry. It is a good omen for the success of other important research activities that may be undertaken in the future.

The number of contributors to the wall stability test fund—about two hundred—is not in the least disappointing when its significance is analyzed.

On first thought, two hundred may seem a disappointing number, an indication that only a few hundred plant managements are sufficiently progressive to see the value of research activities of this character. On the contrary, a glance at the list of contributors, printed in the April and May issues of "Concrete," discloses the fact that they are the same group of progressive manufacturers that always have carried the burden of the industry. They represent the plants that are producing the bulk of the annual output.

The small plant will continue to hold its place in the small community; but the industry in the larger centers is headed quite clearly toward a smaller number of large plants. For the most part, the plants toward which the products business is gravitating are those represented in the list of contributors to the wall stability test fund.

True and False Economy

JOHN W. REID, president of the American Society of Municipal Engineers, drew a sharp distinction between true and false economy in city government, during a recent meeting of that society in St. Louis.

Many times, he declared, the endeavor to hold taxes below a certain figure has resulted in greater cost to the taxpayer. As an illustration, he cited the case of streets that are badly in need of replacement. Too often the tendency is to postpone reconstruction to keep the tax rate down; but year after year the city spends more money in maintaining those rough streets than the interest charges and funding of a reconstruction bond issue would cost. In either case the taxpayer is the fellow who pays the bill.

When a city government adopts the practice of reducing expenditures by side-stepping the construction of needed facilities, Mr. Reid continued, a larger burden will ultimately be imposed on the tax-paying public. Looking at the bargain prices that now prevail in construction work, the city government that does not go ahead with needed improvements as in

normal times is not playing fair with its taxpayers. Above all things, he asserted, work should proceed on projects called for in approved city and regional plans.

Never has the opportunity been greater than at present for genuine leadership in city government. It is unfortunate that not all city officials are capable of handling the situation that confronts them.

Going After the Road Hogs

FROM Belvidere, Illinois, comes the gratifying story of the arrest of a truck driver on charges of damaging street pavements by transporting a 32-ton steam shovel through the city on a trailer. The shovel and the trailer had a total weight of 38 tons.

State highway engineers also were ordered to investigate possible damage to state roads, since the 38-ton load was nearly $2\frac{1}{2}$ times the trailer load of 16 tons permitted by state laws. The trailer itself exceeded the legal width, and because of this excess width the owner of the outfit previously had been denied a state license to operate it.

Along with the development of highway transportation there has developed an utter disregard of state laws and city ordinances dealing with load limits.

State highway departments, more especially, should give far greater attention than is now being given to violators of regulations establishing maximum loads. Cases are entirely too rare in which this particular type of road hog is brought to justice.

Fire Resistance of Concrete Building Units

FROM the abstract of the Department of Commerce Building Code Committee's new report on fire resistance in buildings, printed on pages 23 and 24 of the June issue of "Concrete," it must be evident that concrete masonry building units have won recognition of the highest order.

Two major tasks are now marked out for the concrete products industry, as a result of this recognition.

First, it will be necessary to have these new recommendations of the building code committee incorporated into city building codes, so that present restrictions will be removed.

Second, the good work already accomplished toward the recognition of concrete building units by fire insurance rate-making organizations must be continued.

Here are two tasks that are worthy of the industry's greatest efforts, for complete success means the opening up of a vast market.

PROGRESS—In a Page

◀ Current activities in research, in matters pertaining to concrete and cement, as being carried on or completed by various organized groups. ▶

Federal Specification for Cast Stone Under Preparation

THE Federal Specifications Board, of the U. S. Bureau of Standards, Washington, D. C., is adopting a federal specification for architectural cast stone, to be used as a purchase specification by the various departments and separate establishments of the United States Government.

The specifications, in their proposed form, have been submitted to representative manufacturers of cast stone for their comment and criticism. All criticisms should be in the hands of the Federal Specifications Board not later than Thursday, August 13.

Manufacturers of cast stone, either individually or through their trade association, are urged to obtain copies of the proposed specification from the board, if not already at hand, and to submit constructive criticisms in ample time.

Standardizing Weighing Devices for Concrete Aggregate

STANDARDIZATION of Weighing Devices for Concrete Aggregate is the title of the specification developed by a committee of the American Road Builders' Association and recommended for adoption by a committee representing the American Association of State Highway Officials.

The idea back of this specification is that of overcoming, by standardization, the hardships inflicted on contractors and equipment manufacturers alike because of the lack of uniformity, either in equipment or in specifications.

Part 1 of this specification deals with weighing devices for use with the bin batcher and central mixing type of plant.

Part 2 deals with weighing devices for use with small mixers of $\frac{1}{2}$ cu. yd. capacity or less.

Copies of the specification may be obtained from the American Road Builders' Association, 914 National Press Building, Washington, D. C.

Standardizing Steel Side Forms for Concrete Pavements

A committee of the American Road Builders' Association has prepared a recommendation and report under the title of "Standardization of Steel Side Forms for Concrete Pavements," in which recommendations are made concerning the standardization of sizes and use of such forms in concrete paving work.

The manufacturers of these forms have co-operated with the committee with the view of developing smoother riding pavement surfaces because of the increased area of the form base, and to permit uniformity of manufacture because of the uniformity in requirements.

Copies of this recommendation and report may be obtained from the American Road Builders' Association, 914 National Press Building, Washington, D. C.

Concrete Form Work Practice

The Concrete Reinforcing Steel Institute, Tribune Tower, Chicago, has made a distribution of its code of standard practice in concrete form work, and is preparing to distribute a second publication on form work in concrete joist construction, with special reference to school buildings.

Other similar publications are to be prepared at intervals during the year. Architects and engineers desiring this information should forward a request to the institute to be placed on the mailing list.

Federal Specifications for Coarse Aggregate Promulgated

THE Federal Specifications Board, U. S. Bureau of Standards, Washington, D. C., has completed and promulgated purchase specification SS-C-571 for Coarse Aggregate for Portland Cement Concrete Pavement or Base (Crushed Stone, Gravel or Slag).

The new specification is effective on August 15, 1931, after which it becomes mandatory on all departments and separate establishments of the United States Government in the purchase of these materials.

Copies of specification SS-C-571 may be obtained at 5 cents each from the superintendent of documents, Government Printing Office, Washington, D. C.

Action of Sulphate Water on Concrete

THE May (1931) issue of *Public Roads*, published by the Bureau of Public Roads of the United States Department of Agriculture, contains a 26-page illustrated report by Dalton G. Miller and Philip W. Manson, covering a third series of tests on concrete cylinders stored in Medicine Lake, near Watertown, S. D.

This report records the results of tests made since those that were reported in *Public Roads* of the October (1925) and November (1927) issues.

The new tests include some at 3 and 5 years of cylinders from the earlier series and 1 and 3-year tests of cylinders installed in the lake since 1927. The number of cylinders that have been made for the Medicine Lake experiments now totals well in excess of 20,000, of which more than 9,000 have been actually stored in the lake for time periods up to seven years, and nearly 11,000 stored in fresh water in the laboratory for comparison tests up to five years.

Centrally Mixed Concrete Wins Place in Highway Construction

Good Results with Portable Mixing Plants — Ready-Mixed Concrete From Established Commercial Plants Becoming a Factor—Filling Gaps and Other Special Uses

In this article, the fourth of a series on highway construction practice, the part played by centrally mixed concrete is discussed by highway engineers.

The portable central mixing plant, installed as a part of the contractor's equipment, has won general recognition; but concrete from the established commercial ready-mixed concrete plant has now become a factor. This interesting development is likely to attain increasing importance in the vicinity of cities and large towns.—The Editors.

THE most significant trend in the use of centrally mixed concrete in highway construction is seen in the part just beginning to be played by regularly established commercial ready-mixed concrete plants. The beginning of this phase of highway construction is noted in the comments of highway engineers of several states, in replies to a questionnaire addressed to state highway departments by CONCRETE.

Commercial Ready-Mixed Concrete a Factor

While only three of the replies received make specific mention of the use of concrete from commercial ready-mixed concrete plants, these few seem to indicate a rather definite trend. It is not necessary to be a prophet to see much greater possibilities in this direction in the vicinity of large centers of population where commercial plants are most likely to be located.

The reply from T. H. Cutler, chief engineer, Missouri State Highway Department, mentions the fact that concrete from commercial plants is the only centrally mixed concrete used in their paving work. "The central mixing plant," he writes, "has been used only in such localities where regularly established commercial ready-mixed plants could furnish the material. Satisfactory results were obtained."

T. G. McCrory, chief engineer, Washington State Highway Department, rather clearly favors the established commercial plant in preference to the portable central mixing plant operated as a part of the contractor's equipment. "A central mixing plant," he says, "has been used to some extent in this state. One paving contract was completed by this method with fair success, but we are not very favorable toward it on paving work. The piers

and approaches of a large bridge project are now being concreted from two commercial central mixing plants in the city of Seattle. The haul is short and they are having very good success."

Wm. J. Titus, chief engineer, Indiana State Highway Commission, writes that concrete from central mixing plants has been used in that state to a limited extent only, but that on projects where it has been employed the results have been entirely satisfactory. One of those projects, located near South Bend, was supplied by a commercial ready-mixed concrete plant in that city, as described in the September (1930) issue of CONCRETE, pages 17-19.

Good Results With Portable Plants

The statements quoted above should not be construed as an indictment of the portable central mixing plant set up as a part of the contractor's concreting plant. On the contrary, many states report entirely satisfactory results with such equipment.

For instance, E. H. Kivett, physical testing engineer, Louisiana State Highway Department, mentions the "very



Central mixing plant in operation on state road No. 24, near Remington, Ind.

successful use" of a central mixing plant on a number of projects. W. L. Leshner, materials engineer, Idaho Department of Public Works, mentions the successful use of a central mixing plant on a 3-mile project. Lucius D. Barrows, chief engineer, State Highway Commission of Maine, writes that while the portable central mixing plant has been used but little, results have been "very good on projects where such plants were used." C. M. Ziegler, construction engineer, Michigan State Highway Department, likewise reports satisfactory results with central mixing plants on comparatively small projects; and W. C. Davidson, state highway engineer, Santa Fe, New Mexico, also reports good results with central mixing plant equipment.

A typical central mixing plant of the portable type is shown in the illustration. This plant was erected for use on Indiana Project No. 143-A, extending from Remington, Ind., to the Illinois state line, on state road No. 24. The plant included a 14-bag, 56-S batch mixer, which discharged by tilting forward. Cement was carried to a hopper by means of a belt conveyor.

Other states in which satisfactory experience with centrally mixed concrete has been reported, though used only to a minor extent, include Arkansas, Nebraska, North Carolina and New Jersey (the last named state reporting fair results).

Some use of centrally mixed concrete is reported from Illinois, Virginia and Ohio, but without comment. Seven states reported having used no centrally mixed concrete, and two states—Oregon and Mississippi—are reported as opposed to its use in the former state and at least not encouraging it in the latter.

Centrally Mixed Concrete for Special Purposes

Several highway engineers mention the use of centrally mixed concrete for special purposes, such as filling in gaps. L. M. Dinsmore, office engineer, Alabama Highway Department, reports satisfactory results on work of this nature; and in Texas it has been employed in a small way in supplying concrete to points where small quantities of material were required.

Prefer Proportioning Plant

In California, according to C. H. Purcell, state highway engineer, a preference is shown for central proportioning plants. Central mixing plants, he says, have not been used recently.

On the whole, it may be said that, with the two exceptions noted, the use of portable central mixing plants is largely optional with the contractor. As suggested at the beginning of this article, concrete from commercial ready-mixed concrete plants may be expected to be used in increasing amount.

How to Take Quantities for Tin-Pan Floor Construction

What is probably a more direct method for taking quantities for concrete floors of "tin-pan" construction than that given in the article "Estimating Cost of Concrete Work" in the June issue has been suggested by a reader.

Charles S. Barr, of Love and Barr, architects and engineers, Monroe, Louisiana, writes:

In reading over the first of the series of articles on "Estimating Cost of Concrete Work" in your June issue of CONCRETE, I was interested in that part of the paragraph on page 15, just before "Concrete Costs," which refers to "tin-pan" construction. The author, Mr. Allen, speaks of estimating the concrete quantities in such construction by "taking a typical bay or panel and compute the average thickness of concrete in slab and ribs and then apply this figure to the whole area of the floor." While there is nothing wrong with this method, I have found that a much more accurate method is to figure the slab over the entire area as being the total thickness of slab and pan, and then deduct the volume of concrete displaced by the pans. Most all of the companies selling pans use this method, as well as most of the contractors. If you are using 10-in. pans and a 2-in. slab, you figure the area as a 12-in. slab, and deduct for the pans. The volume of the pans is obtained by multiplying the total lineal feet by the volume per foot. This method takes care of all concrete in tees of the T-beams.

I am looking forward to reading the new series of articles entitled "Cutting Corners in Concrete Design."

CHARLES S. BARR.

Ninety Grade Separations Planned by Wisconsin

Wisconsin's construction program calls for the erection this year, with the co-operation of the railroads, of 90 overhead highway crossings at railroads. No less than 26 crossings had been awarded for construction by the middle of May and bids had been received on seven more. Since then ten others have been advertised for bids.

The entire program was originally to have been carried out over the three years, 1931 to 1933.

Personals

J. W. Kelly, formerly associate engineer in the research laboratory of the Portland Cement Association, has joined the engineering and research division of the National Sand and Gravel Association, with headquarters in the Munsey Building, Washington, D. C. For the present he is located at Milwaukee, conducting a special investigation of Wisconsin sands and gravels.

Mr. Kelly has been engaged for some years in conducting special classes in the proper proportioning, mixing and placing of concrete. These classes, sponsored by the Portland Cement Association, were held in all parts of the United States and Canada.

J. C. Pearson, of the Lehigh Portland Cement Co., Allentown, Pa., has been appointed as one of the Portland Cement Association representatives on the Joint Committee on Specifications for Concrete and Reinforced Concrete, succeeding Ernest Ashton, formerly vice-president of the Lehigh Portland Cement Co., who has resigned.

Profitable Manufacture of Concrete Building Units

Principles of Correct Mixing—Theoretical and Practical
Grading for Minimum Cement Consumption and Maximum Strengths—Differences in Curing Methods

VII—Technical Manufacturing Problems

By FRED A. SAGER
Consulting Industrial Engineer

There are few departments in most products plants in which savings cannot be made by the adoption of improved methods and technique. Mr. Sager has had unlimited experience with both of these factors in the manufacturing end and below he passes on to other products manufacturers the most valuable of this information.—The Editors.

THE problem in the manufacturing plant is that of combining the raw materials into a suitable product at a minimum cost. This problem is both technical and mechanical. It is technical in so far as the quality of the product is influenced by such matters as grading of aggregate, and the processes of mixing the concrete and molding and curing the product are concerned. With the methods of carrying out these processes determined, there remains the mechanical problem of design of machines and facilities to accomplish the desired result and that of handling the tonnage of material from the raw material to the finished product storage.

Importance of Grading Aggregates

The technical problem was touched on in the last paragraphs of the section on "Handling and Storage of Raw Materials" on page 30 of the June issue of CONCRETE, and it may be well, at this point, to give brief consideration to the technical side of products manufacture as it involves the questions of grading of aggregate, mixing of concrete, molding the units and curing the product. The matter of grading was considered in the June issue in relation to its effect on the quantity of cement required and the uniformity in texture of the product. Theoretically, the grading with the coarse aggregate of the largest size practicable and with all these large pieces of the same size, and with the resulting voids then filled with the next largest size that will fit in the voids, and so on down to the finest size, will require the least amount of cement. This consideration is academic, in that at present the processes ordinarily used in making concrete will not permit of its full application. If, however, the principle is held definitely in mind, it may be approximated to advantage, as closely as may be possible with the mate-

rials and equipment available in any given plant. This matter will be brought up again in a later paragraph.

Grading Requirements for Products Plant

A general rule in wide use specifies the maximum size of the aggregate as one-quarter of the smallest dimension of the work into which the concrete enters. In the case of the standard 8-in. block with 2-in. walls, this would limit the coarse aggregate to $\frac{1}{2}$ -in. size. For the 4-in. block with 1-in. walls, the size would reduce to $\frac{1}{4}$ -in. Many plants use the same mix for each unit, but if screening equipment is installed for cinder block plants or separate bins for aggregate provided for other plants, suitable variation can be made, and should be made in the grading, when making different units, with advantage so far as the texture of the product is concerned. The technical requirements as to grading are, for a products plant, that the crushing and screening equipment, or the specifications for purchase of prepared aggregate, shall be such as to provide suitable maximum sized aggregate for any given unit of production and then the proper proportioning with finer aggregate to get the specified quality with the minimum amount of cement.

The Problem of Mixing

The matter of mixing has been given extensive consideration in the industry, and in many classes of concrete work the type of mixer and the time of mix are specified. It is realized that the aggregate should be thoroughly mixed, the cement uniformly distributed, all surfaces coated with the mortar of cement and water and the amount of water limited. The amount of water used in ordinary mass concrete is generally more than is required for the necessary chemical action and results in a decrease in the strength of the concrete. Such excess is desirable in order to obtain a "workable" mixture or one that can be put in the forms with assurance that the mass will be free from pockets or voids. With these wet mixes it is reasonable that the quite fluid cement-water mortar will soon coat all surfaces of the aggregate during the mixing process and also that the aggregate will soon become arranged with a uniform distribution of varying sized pieces. The mixing time for such concrete is usually specified 1 minute or slightly more with the standard type of mixing equipment.

In the case of products manufacture, when the usual type of block machine is used a much dryer mix is used,

as it is necessary immediately to remove the molded concrete from the machine. With the dryer mix it appears that a longer time is required fully to coat all surfaces, as might be anticipated. The results of numerous tests show that a mixing time of 1 minute, and even 2 or 3 minutes, gives a strength far below that of a 5-minute mix. In general it appears that not less than a 5-minute mix is standard in most products plants. References have been noted, in discussions of this matter, of the time required for certain chemical actions to take place, but to the writer it appears that the essential thing to be accomplished is a thorough mixing and a complete plastering of all surfaces of aggregate with the cement-water mortar. With a concrete thus prepared and placed in the product, the chemical action necessary to transform the plastic mix into the artificial stone (concrete) can and will proceed at its own rate, influenced, as is well known, by the temperature and moisture conditions maintained for the product and by the fineness of the cement. As to the plant design, the mixer capacity should be such as to turn out the required amount of mixed concrete with at least a 5-minute period of actual mixing.

The Process in the Block Machine

The process in the block machine is that of taking the mixed plastic concrete and compacting it in the mold box into the form that will be retained by the artificial stone that finally is developed in the finished products storage yard. In all products a specified strength will be required. In many products a certain degree of imperviousness is desired, which quality increases as the voids in the finished product are eliminated. This is accomplished in monolithic concrete by the use of a rather wet, over-mortared mix, which contains from 0.77 cu. yd. to 0.92 cu. yd. of coarse aggregate per cu. yd. of concrete. This means that the pieces of large aggregate are separated from each other and are, in the plastic state, floating in the mortar of fine aggregate, cement and water. This condition gives the necessary "workability" and sacrifices a certain amount of strength due to the excess of water in proportion to the cement. In case of block made in a machine, the compacting is done by pressure applied in the hydraulic machine or by the blows of the tampers; and the dryer mix necessary can be converted into a dense product. Both of these mixes may be over-mortared with the result that the strength of the product depends principally on the strength of the mortar. In order to develop properly the strength of the aggregate there should be numerous contacts between the pieces of the aggregate in all directions throughout the mass. Such closely packed aggregate forms a skeleton of strength, the pieces held in place in the block by the mortar filling the voids between the pieces of compacted aggregate. This product is not over-mortared.

Theoretical Grading of Aggregates

We will refer again, and for the last time, to the grading theoretically required for the minimum cement consumption and probably the maximum strength. Assume the large aggregate in the form of 2-in. spheres, arranged in regular order in a cubical box one yard on a side. The box is full of these spheres and they are all in stable contact with adjacent spheres, so long as the sides of the box hold them in place. When arranged in the most com-

pact manner, their total volume is 73.95 per cent. of the volume of the cubical box. Then assume the spaces between these spheres to be occupied by the largest spheres that can be fitted in, which will be about 0.83 in. in diameter; and of these there will be the same number as of the 2-in. spheres, and their volume will be 5.34 per cent of the volume of the box. The third size that can be fitted into the remaining void spaces is about 0.2 in. in diameter, but the number of this size is about 150 times that of the 2-in. spheres and their total volume is about 11 per cent. Then will follow a still larger number of spheres of the next smaller size, about 0.026 in. in diameter, with a total volume of about 1.26 per cent. The last size is of the order of the size of sand particles. The spaces between these spheres would contain only spheres of 0.008 in. diameter, which is approaching the size of cement particles, 0.005 in. for cement particles just passing a 200-mesh screen. Further calculations have not been made, but some generalizations may be drawn from the results set up in tabular form, as follows:

Diameter of sphere, in inches.	Volume occupied, per cent	
	For one size	Accumulated total
2.000	73.95	73.95
.828	5.34	79.29
.200	11.00	90.29
.080	5.83	96.12
.026	1.20	97.32
.005	2.68	100.00

The large spheres occupy as aggregate the same space as is occupied in the finished concrete. The second size is about 1/3 the diameter and is used in about 1/15 the amount of the large size. The third size is 1/10 the diameter and is used in about 1/6 to 1/7 the amount. The fourth and fifth sizes, like fine gravel and sand, are used in small amounts, the total volume figured being 97.32 per cent. If the remaining space is filled with spheres, say of cement, 0.005 in. in diameter and less, it will take 2.68 per cent of the box volume, or 0.725 cu. ft.; and if the then remaining space between the spheres of cement is filled with water, it will be added at the ratio of 1.8 gallons per sack of cement. If this amount of water is sufficient for the necessary chemical reaction, the strength of the mortar should be well above 6,000 lb. per sq. in., the limit of the curves at hand, which value is applicable to a ratio of 3 gallons of water per sack of cement.

Such a hand-picked aggregate made into a hand-placed concrete would not be over-mortared nor over-wet. The tiny cement spheres would be interspersed among, would lie alongside (coat) all surfaces of the aggregate not in contact with other aggregate surfaces, would fill all remaining space (voids), and when set by the addition of water, would hold all pieces of aggregate in place with strength increased by the low water-cement ratio. The larger pieces are all in mutual contact and between them are wedged the smaller spheres, forming a skeleton of the aggregate whose strength should closely approximate that of an individual piece. It may be noted that the total volume of the spheres, cement and water entering into this concrete is about 1.38 cubic yards, as contrasted with the 1.53 cubic yards found for ordinary mixes of monolithic

concrete. This follows directly from the voids of about 25 per cent occurring between closely placed spheres, contrasted with the voids of from 30 to 40 per cent occurring in usual aggregates.

This academic consideration of concrete composed of perfectly graded hand-placed spherical aggregate could be approximated in practice by the use of a closely graded aggregate of the largest size that could be used in the given product, with relatively small quantities of the smaller sizes, properly graded, the smaller sizes and the cement being used in sufficient excess to float the smaller sizes into position between the pieces of the large sized aggregate, this latter being the "workability" requirement, a necessity in the ordinary placing of monolithic concrete. Ordinary coarse aggregate contains a certain percentage of finer pieces down to perhaps 1/6 the maximum size, and the size and proportion of these finer pieces might chance to be the ideal grading; but in general the chances would fall the other way. The proportion of sand commonly used is far in excess of the theoretical requirement, and while better grading of the coarser aggregate might effect a reduction in the amount of sand and cement as well, the "workability" requirement will limit this reduction.

With the forcible compacting accomplished in machine-made products the theoretical result can be more closely approximated, as is evidenced by the difference between a production of 12 or 13 units per sack of cement and that of 17 to 22 units per sack obtained with careful grading.

Comparison of Curing Methods

The process of curing the product has been given extensive investigation and the necessity for sufficient moisture to advance the curing is well known. The effects of steam curing with temperatures up to 125 deg. F. have been determined, and such methods are in common use with satisfactory results in that 24 hours of such curing develops a 3 or 4-day moist air curing strength and permits the product to be yarded with negligible breakage and, in usual weather, with enough moisture to complete the curing process. More recently high-pressure steam curing has been done with 100 pounds steam pressure (about 335 deg. F.). With 12 hours of such steaming followed by 12 hours slow cooling, there has been developed the normal 28-day strength at the end of 24 hours. It may be that such high-pressure curing will have a wider application in many products plants. The necessary facilities would add to the plant cost, but the stock of finished product could be reduced by the amount now carried as uncured stock, the uniformity of curing would be definitely assured and the curing would be independent of weather conditions. Without steam curing, attention has to be given the product for several days to assure the moisture necessary during the longer curing period.

Detroit Chosen for 1932 Road Builders' Show and Convention

The American Road Builders' twenty-ninth annual convention and road show will be held at Detroit, January 9 to 15, 1932.

Headquarters hotels will be the Statler and the Book-Cadillac. Division headquarters will be maintained at these hotels.

The Detroit Airport building will be used for both the convention and the road show. All exhibit space is on the ground floor.

Ready-Mixing Plant Editorial Called "Sensible"

The timely caution against the ill-considered duplication of ready-mixed concrete plants, which appeared on the editorial page of the June issue of CONCRETE was "very much to the point," according to a prominent middle western ready-mixing plant operator.

His letter follows:

Editor,
CONCRETE Magazine,

I want to congratulate you on the very sensible editorial on Ready-Mixed Concrete appearing on page 25 of your June issue.

I think these remarks are very much to the point, and that more discussion along this line will aid to avoid a great deal of difficulty to responsible and properly organized ready-mixed concrete operators.

Cutting Corners in Concrete Structural Design

The new series of articles on "Cutting Corners in Concrete Structural Design," promised in last month's issue, will supply structural designers with well-arranged devices for saving time on design computations. Special problems to be treated will include—

1. Flexural properties of concrete.
2. Slide-rule method of designing beams and slabs.
3. Use of compression steel in concrete beams.
4. Over-reinforced beams and slabs.
5. T-beam curves.
6. Table for design of one-way tile-and-joist floor slabs.
7. Load distribution in two-way floor system.
8. Load factors applying to discontinuous uniform loads on continuous beams.
9. Design charts for spiral columns.
10. Chart for design of reinforced concrete stair construction.
11. Chart for determining allowable projection of unreinforced foundation projections.

J. R. Goetz, the author of these new "short-cuts," is a well-known structural engineer of Chicago. For eight years he was chief engineer for Ben Marshall, one of Chicago's leading architects.

Because of lack of space in the August issue it may be necessary to defer the beginning of this new series until the September issue, after which they will be a regular monthly feature.

Testing and Inspection of Concrete Have Definite Value

Gain in Strength of Cement Since 1920—Principal Tests for Aggregates—Function of Admixtures—Concrete a Product of Many Factors

By JAMES H. HERRON
President, The James H. Herron Company, Engineers and Chemists,
Cleveland, Ohio

THE value of a cement is determined by tests during a period of years. Table 1 shows the strengths of eight different brands of cement.¹ These results are the average of one hundred or more tests for each brand, in the years of 1920 and 1929. It will be noted that during the period of nine years every cement manufacturer has increased the strength of his cement. The increase of strength values runs about one-third. It will also be noted that the strength varies with different brands of cement.

TABLE 1

Tensile Strength of 1:3 Standard Ottawa Sand Mortar, in Lb. per Sq. In.

Brand of Cement	1920		1929	
	7 days	28 days	7 days	28 days
No. 1	210	310	350	440
No. 2	230	316	330	440
No. 3	250	323	320	430
No. 4	227	335	315	400
No. 5	240	330	305	400
No. 6	225	305	295	397
No. 7	207	305	285	375
No. 8	255	315	260	355

Average of 100 tests or more for each brand of cement.

Variations in Cement Cause Variations in Concrete

Brands of cement of different strengths will give corresponding values in concrete. This is borne out by results shown in Table 2, from tests of concrete employing the same sand and coarse aggregate in each case, but with the brands of cement indicated in Table 1. These results are an average of more than 100 6 by 12-in. cylinders for each brand of cement, made up with 6 gallons of water per bag of cement.² It is seen that the concrete reflects the strength of cement used, and that the higher strength cements in all cases give higher strength concretes, both at 7-day and 28-day periods.

Condensed from paper presented to the Concrete Division of the Cleveland Engineering Society.

¹From the laboratory of the James H. Herron Company, Cleveland, Ohio.

²From the laboratories of the James H. Herron Company, Cleveland, Ohio.

FINE AGGREGATE

There are a number of things which enter into the selection of a fine aggregate as the second component of concrete. The tests which are ordinarily made indicate what should be known, and include (1) sieve analysis, (2) comparison in strength with standard sand, (3) organic contamination, and (4) the presence of silt and other particles which are unsuitable for concrete.

Sieve Analysis

If properly graded sand is used, less cement is required to fill the voids with cement paste, and a more workable or plastic concrete is obtained. To render any mixture plastic or workable the voids must be filled to a slight excess, so that one particle of the aggregate will move over another particle without great frictional resistance. If the voids are large there is not enough cement paste properly to fill them. It then becomes necessary to add more water. This additional water occupies space. When it finally works to the surface and evaporates, there are left empty pockets, commonly called water voids, which render the concrete porous. A porous concrete is rarely stable and offers the chance for corrosion and frost action because its interior is accessible to water through absorption.

Function of Admixtures

Frequently the sands are lacking in fines. This can be corrected by adding such fines whether as sand or some other admixture. The principal function of the so-called

TABLE 2

Compressive Strength of Concrete, in Lb. per Sq. In.

Brand of Cement	Compressive strength at age indicated	
	7 Days	28 Days
No. 1	1720	3100
No. 2	1650	2920
No. 3	1695	3105
No. 4	1545	2815
No. 5	1576	2890
No. 6	1495	2650
No. 7	1520	2500
No. 8	1335	2403

Average of more than 100 6 by 12-in. concrete cylinder tests for each brand of cement.

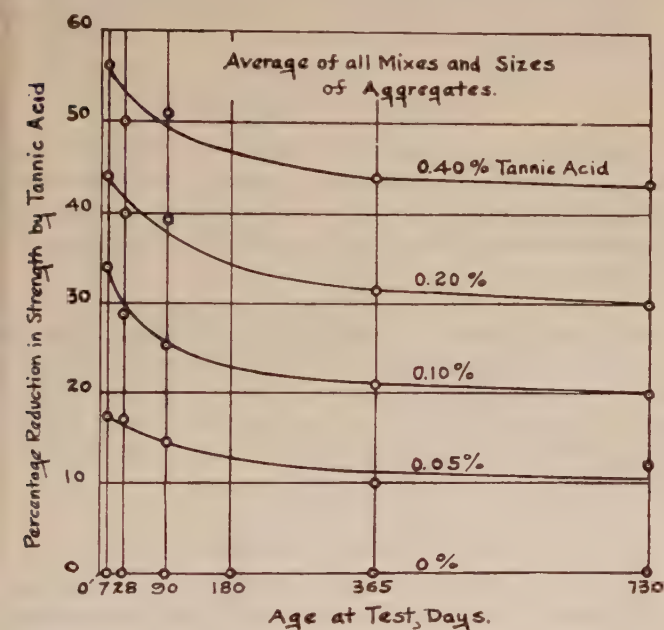
Six gallons of mixing water used per sack of cement.

admixture is to supply the finely divided material which is desirable to render the sand of the proper grading. The judicious use of fines can serve to keep the water content down, resulting in denser and stronger concrete.

Organic Contamination

Many sands of bank origin are contaminated organically. This is due to the humic acid which percolates down through the sand from the overlying top soil. Trees and grass roots are other sources of contamination when the sand is taken too near the surface. There is a limit to which organic contamination is permissible.

Organic acids introduced in this way tend to neutralize the active element of the cement, ultimately leaving the concrete in the form of a loose aggregate. In other words, organic contamination may prevent the hardening of the cement in part or entirely, depending on the amount of contamination. Some study has been made on the effect of organic contamination in terms of tannic acid by Duff A. Abrams. The chart shows the reduction in strength for various percentages of humic acid.³



Reduction in strength of concrete of different ages, caused by tannic acid.

Silt Harmful in Form of Coating

The term "silt" is used to represent very fine earthy material in sand. A small amount of free finely divided material in sand does not seem to detract materially from the strength. The percentage can run comparatively high without detriment if there is no excess of fines in the sand. However, when the silt is found as a very thin coating on the grains of the aggregate it is highly injurious, and less than 3 per cent may render the concrete of little value.

COARSE AGGREGATE

The tests of coarse aggregate, the third component of concrete, are similar to those of fine aggregate, but do not involve quite so many.

³Effect of Tannic Acid on the Strength of Concrete. Duff A. Abrams, Bulletin No. 7, Structural Materials Research Laboratory, Lewis Institute.

Analysis Essential

The sieve or screen analysis is essential in order to determine the grading of the material. Here again is the requirement to have an aggregate which has a minimum of void volume in order to reduce the required mortar content.

Organic Contamination

Organic contamination in a coarse aggregate is not usually considered except in gravel, or in stone, when the source of material is near the surface of the ground.

Soundness

Soundness is an important matter with respect to coarse aggregate. Unless the material is strong and durable it may show low strength value in the concrete, and if the aggregate is porous it may result in disintegration under frost action. The usual test to determine the resistance to disintegration is the actual freezing and thawing tests, or the more accelerated sodium sulphate test.

Aggregate Bodies

Aggregate bodies unsuitable for use in concrete are of three kinds:

- (1) The flat shapes, which are commonly called shingle. These will tend to form pockets because they are not adapted to fit into the most compact arrangement.
- (2) Elongated shapes, which will not properly fit in with the other particles of aggregate to form a compact mass. These also cause pocketing, of a different character.
- (3) Pieces of the material which are friable. Sometimes these are of a concretionary origin and somewhat chalky in character.

CONCRETE

Concrete is not alone a mixture of cement, water, fine aggregate and coarse aggregate, but its quality depends also on the care in mixing and care in placing and curing. Any variation in any of these factors produces a corresponding influence in quality. A knowledge of these factors is acquired by information gained from testing the materials and the resulting product. The testing itself covers the cement and the aggregates, probably the water if it is believed to be contaminated with organic matter, and the concrete.

Scope of Testing

The inspection covers the quality and quantity of water, the care and time of mixing, and the care in placing and curing concrete. It will therefore be apparent that constant testing of concrete materials and reliable inspection of the work involved are valuable aids to satisfactory concreting.

Development of Technique

The development of the state of the art to date is the result of careful testing and the drawing of proper conclusions from the tests. In this way the value of cement has been increased, proper specifications for the aggregates have been evolved and suitable methods have been developed for the mixing and placing of the concrete. While the work to date has been tremendous it is necessary to continue this work to further improve the state of the art and develop technique in concreting operations.

New Books and Pamphlets

Estimating Building Costs

ESTIMATING BUILDING COSTS, second edition, 1931. By Charles F. Dingman. Published by the McGraw-Hill Book Co., Inc., New York. Cloth binding, 277 pages, 4 by 6½ inches, illustrated. Price \$2.50.

Since the publication of the first edition of this book, in 1923, many important changes have occurred in the manner of handling building operations, and these changes have necessitated corresponding modifications of the methods of estimating building construction costs.

Among the most important changes, all of which have been provided for in this new edition, the author mentions the almost complete motorization of material haulage, so that figures based upon the use of horses for hauling and other operations can be applied to only a small percentage of the projects likely to be considered by an estimator.

Other changes are the increasing use of power shovels and other types of excavating equipment, the use of portable saws, drills and other small tools, with the consequent elimination of hand labor, and the changes in the ideas and methods in making and placing concrete.

United States Earthquakes in 1928

UNITED STATES EARTHQUAKES, 1928, is the title of a new publication known as Serial No. 483, issued by the United States Coast and Geodetic Survey of the Department of Commerce.

This publication contains, for the calendar year 1928, information regarding all the principal earthquakes in regions under the jurisdiction of the United States except earthquakes of volcanic origin in the Hawaiian Islands and earthquakes of volcanic origin or of minor importance in the Philippine Islands. Earthquakes adjacent to the United States and felt within its borders or those of its territories or possessions are described except that, in the case of Canadian earthquakes felt within the United States, a general description only is given, as details are shown in the Canadian reports. As a reciprocal arrangement, the earthquakes of origin within the United States felt in Canada are published in detail in this volume.

Pavements for Modern Traffic

PAVEMENTS FOR MODERN TRAFFIC is published by the Portland Cement Association.

Street problems which concern city officials, business men and property owners are discussed. Such topics as the value of good pavements to a community, and concrete paving practice on steep grades, between car tracks, on heavy traffic streets and elsewhere, are discussed.

Tests by R. Feret

RESISTANCES DES BETONS AU CHOC, A L'USURE ET AU DECOLLEMENT, COMPAREES A LEURS RESISTANCES A LA COMPRESSION, A LA FLEXION ET A LA TRACTION (Resistance of Concrete to Impact, to Wear and to Disintegration, Compared with its Resistance to Compression, to Flexure and to Tension) is the title of a 72-page, 9½ by 12½-inch

treatise by R. Feret, published by La Revue des Matériaux de Construction, 148 Boulevard de Magenta, Paris.

This publication consists of reprints of a number of articles and papers by Mr. Feret, who is director of the laboratory of the department of roads and bridges, at Boulogne-sur-Mer, France. The results of numerous tests of concrete are shown in curves and tabulations, and discussed in the text.

Ready-Mixed Publication

ESTIMATING QUANTITIES FOR CONCRETE is the title of a 12-page, 8½ by 11-inch bulletin issued by the National Ready-Mixed Concrete Association, Munsey Building, Washington, D. C.

This bulletin is one of a series to be prepared by the engineering division of the association, designed to supply information of value to users and producers of ready-mixed concrete. The present bulletin first appeared as a paper read by the author, Stanton Walker, before the annual meeting of the National Ready-Mixed Concrete Association at St. Louis, on January 26, 1931, an abstract of which was published in the April issue of CONCRETE, pages 27 and 28.

Book of Facts

CONCRETE FACTS FOR CONCRETE CONTRACTORS, a new 48-page illustrated publication issued by the Portland Cement Association, 33 W. Grand Avenue, Chicago, is of special value to contractors engaged in concrete construction work.

The scope of the booklet, which contains many diagrams and a number of halftones to illustrate working procedure, covers subjects such as the selection of materials, proportioning of concrete, mixing and placing concrete, curing methods, floor and surface finishes, water-tight concrete, high-early-strength, colored concrete work, and placing concrete during cold weather.

Ornamental Concrete

COLORÉD CONCRETE. By Almo B. Simmons. Published by Ornamental Concrete Institute, 119 North Main Street, Salt Lake City, Utah. Paper cover, 6 by 9 inches, 109 pages. Illustrated with numerous line drawings.

This book treats many phases of ornamental concrete work, including the reproduction of effects having the appearance of marble, granite, tile, baked pottery, travertine, terrazzo, sandstone, and two-tone work. The making of ornamental one-piece fireplaces, garden benches, table tops and other products is fully described and illustrated. One chapter deals with the making of plaster molds.

Three-Language Technical Dictionary

HUBERT HERMANNS TECHNO-DICTIONARY, second edition, revised and enlarged. By Hubert Hermanns, consulting engineer, Berlin-Lichterfelde, Germany. Published by the author. Stiff paper cover; 432 pages; 4½ by 6 in.; price \$3.75.

This technical dictionary is arranged in three parts. Each part has the words of one of the three languages arranged alphabetically, followed by the corresponding words in the other two languages. The vocabulary includes industrial engineering terms, about 5,000 words in each part.

Inverted Concrete Siphons Designed for Irrigation Projects

Transition Design Avoids Clogging at Intakes—Construction of Forms Described in Detail—Placing and Curing Concrete

By G. D. HALL
District Engineer, Yakima County, Washington

IT is generally known that the short inverted siphon, which is commonly used to convey irrigation water under highways and railways, frequently is the source of considerable difficulty to the operators of irrigation systems, due to weed and trash jams at the intakes. Because this condition often causes canal breaks, managers of irrigation projects frequently refuse to install siphons where they consider the operating condition hazardous. Such conditions often result in expensive changes in the grade lines of highways and railways and, in some cases, necessitate relocation of the canal or highway or both.

A Siphon That Passes Trash

Engineers managing canal systems generally agree that a structure which permits the trash to pass through the siphon reduces the operating difficulties and permits the installation of inverted siphons at critical points.

The first installation of a structure designed to prevent weed jams is on the Sunnyside unit of the Yakima project, built in 1922. This is a concrete box culvert 6 ft. wide by 2 ft. deep, the bottom of the deck slab being set slightly above the maximum water surface. The center 20 ft. of the deck slab is level and the ends are sloped up to 1 ft. in the outside 3 ft. The sides are straight, as the width of the culvert is practically the same as the canal. This canal is very flat (the mean velocity at peak discharge being about 1 ft. per second) and difficult to operate, for the slightest obstruction will cause a weed jam. To date, there has never been a jam caused by the culvert, since the sloping roof and smooth interior do not impede the movement of either the dry weeds that float high or the water-logged trash that floats submerged.

Transitions Carefully Built

The success of this structure convinced the writer that a carefully built transition installed at the ends of siphons having a minimum diameter of 24 in. and a mean velocity at maximum discharge of not less than $1\frac{1}{2}$ ft. per second can operate without interfering with the flow of water, providing the water does not carry silt particles larger than fine sand. Where the silt particles include coarse sand, the safe mean velocity at maximum discharge is not less than 2 ft. per second. The minimum of 24 in. diameter was established after observing the character and size of the trash and "tumble weeds" in the canals.

During the winters of 1928-29, nine siphons of the type illustrated in the line drawing were constructed on different laterals and projects, the diameters being as follows: Two at 24 in., one 27 in., two 30 in., one 33 in.,

and three 36 in., conveying from $4\frac{1}{2}$ to 23 cu. ft. of water per second. These were observed closely all season by the engineers in charge of the projects and by the writer. At no season of the year did the depth of silt exceed 3 in.

How Forms Are Built

Forming for this irregularly shaped structure was developed after constructing five or six siphons. The



Transition walls of concrete at intake prevent clogging of siphons.

most economical method involved the construction of a trapezoidal template for the end section and a circular template to fit inside the pipe. The circular template is of less diameter than the pipe, to permit the sheathing material to be placed between the template and the pipe. These frames are set on the bank in the same position as they are to occupy in the canal, and the intermediate frame or frames (as required by stiffness of sheathing) is constructed to dimensions determined by lines stretched from the two end frames or templates.

The sheathing ordinarily used consists of two layers of 3-in. bevel siding. This material works well on the reverse bends required. After the form is completed and the excavation made to the required dimensions, the form is placed in position and an outside form 8 in. high is set around the top. The floor is not formed and the sides of the excavation are used for the outside form as far as practicable. Sheet metal or composition boards as sheathing probably will also give good results, but the writer has not had an opportunity to try these materials.

Placing Concrete and Backfill

After "loading" or bracing the form to prevent "floating," the floor is placed and concreting continued in the walls in layers not to exceed 6 in. and as near level as possible. As the majority of structures are smaller than

Building Permit Values Show Gains in Many Large Cities

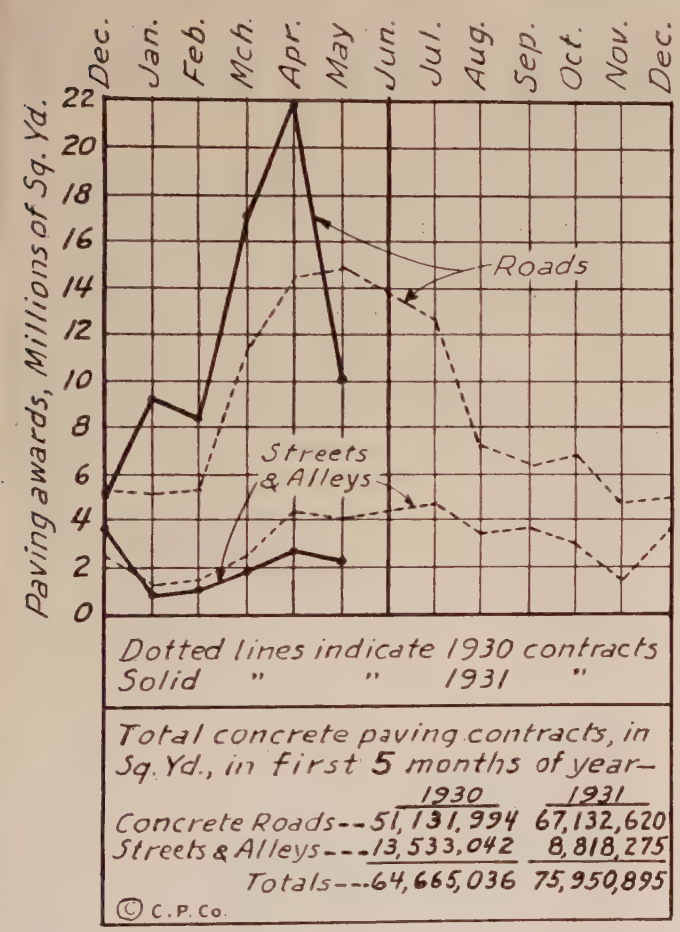
Bright Spots in New England, Atlantic Coast States, Ohio, Northwest and South—Paving Contracts Lower

Probably as a natural reaction to the heavy volume of concrete highway pavement work awarded in March and April, awards during May fell to a level below that of May, 1930, according to reports received by the Portland Cement Association. Road contracts in all previous months of this year have been well above last year, so that total concrete highway contracts during the first 5 months of 1931 are still far ahead of last year, standing at 67,132,620 sq. yd., compared with 51,131,994 sq. yd. in the first 5 months of 1930.

Concrete street and alley paving continues well below

below May, 1930. There is much significance, however, in the fact that a number of large cities issued building permits of greater value in May of this year than in May, 1930. These include the New England cities of Boston, Cambridge and Hartford; Syracuse and a number of smaller cities in New York state; Reading, Pa.; the Ohio cities of Cincinnati, Columbus, Dayton and Youngstown; Washington, D. C.; Norfolk and Indianapolis; St. Paul and a number of smaller cities in the Northwest; Fort Worth and a number of smaller cities in Texas, and Denver, Colo.

Furthermore, in New York City, Buffalo, Albany, Baltimore, Toledo, Minneapolis, Atlanta, Birmingham, New Orleans, Salt Lake City, San Francisco and Tacoma, May building permit values were very close to May, 1930. All this indicates that general building construction is in a healthy condition in certain sections.



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1930, now totaling 8,818,275 sq. yd. for the first 5 months of 1931, compared with 13,533,042 sq. yd. in the corresponding part of 1930.

General Construction Contracts. Contracts for general construction work compiled for the 37 states east of the Rocky Mountains by the F. W. Dodge Corporation, while continuing to show a few bright spots, are reported as totaling \$306,079,100 in May, compared with \$457,416,000 in May, 1930. This brings the total for the first 5 months of this year to \$1,476,773,100, compared with \$2,037,814,900 in the first 5 months of 1930.

Building Permit Values. The total of building permit values reported from 555 cities in the United States by S. W. Straus & Co. for the month of May fell 30 per cent

Lime Association Continues Program of Research

Annual Meeting Sanctions Plans for Research and Aggressive Promotion of Lime in Construction

The use of lime in mortar, alone and with portland cement, was one of the major subjects on the program of the thirteenth annual convention of the National Lime Association, held at White Sulphur Springs, W. Va., June 3 and 4.

Lime as an admixture in concrete was also subjected to informal discussion on the floor of the convention.

Mortar supplied the topic for considerable discussion following the presentation of a paper on the "Essential Properties of Mortar in Brick Masonry," by L. A. Palmer, American Face Brick Association research associate at the U. S. Bureau of Standards. "Repairing Leaky Masonry" was the subject of a paper by Stanley Newman, Boston, Mass.

Plans for research and promotional work for the coming year include a continuation of the 3-year research program inaugurated in July, 1929. This year's program will be devoted almost entirely to mortars suitable for unit masonry construction.

A popular feature of the convention program was the presentation of a two-act play entitled "Merchandising Lime."

Strength and Stability of Walls of Concrete Masonry Units

The tests recently completed at the University of Illinois, under a co-operative arrangement between the university and the Concrete Masonry Association, have supplied the concrete masonry unit industry with information of importance to every manufacturer.

An abstract including the outstanding features of the test results, presented to the annual meeting of the A. S. T. M., will be printed in "Concrete" in the near future.

HOW TO DO IT

♦ Questions and Answers ♦
Consultation and Comment

◀ A department devoted to the solution of problems encountered in concrete work. Readers are welcome to add to or improve upon the suggestions printed and to submit their views for possible publication. ▶

Consent to Employ Higher Working Stresses

Are the Griffith charts for the design of reinforced concrete available for use where a city building code specifies working stresses of 650 lb. per sq. in. for concrete and 16,000 lb. per sq. in. for steel reinforcement?—S. S. C., White Plains, N. Y.

Griffith design charts are not available for the working stresses you mention. Those lower values were omitted because the higher stresses included in the 38 charts are now almost universally employed.

While many city building codes, more especially those which have not been revised in many years, continue to specify the lower stresses formerly used, architects and designing engineers known to be competent can often obtain formal consent from the city building inspection department to employ the American Concrete Institute regulations for the design of reinforced concrete structures.

One well known consulting structural engineer who has supplied structural plans for buildings in many sections of the United States informs us that he has never failed in obtaining such consent when a formal written request was made.

Leaky Basements Again

In our city we have a number of concrete basement walls that permit leakage or seepage during rainy weather. What is the cause of this seepage and how may it be stopped?—C. J. W., Xenia, Ohio.

The conditions you mention usually occur in cases where the builder was interested more in saving a little cement than he was in making good concrete. As a natural result, there is not enough cement in the concrete to make it watertight.

Trouble of this kind can usually be corrected by some method similar to that described on page 42 of the December (1930) issue or on page 44 of the issue of September, 1930.

One of these methods consists of the application of two coats of cement-and-sand mortar to the inside face of the wall, after first chipping away all disintegrated concrete and cleaning the wall thoroughly. The cement should be rather quick-hardening, if such a cement is available. If not, ordinary gray portland cement may be used, especially if the leakage is not bad at the time of making repairs.

The method just described is intended for cases where the water seeps through the walls. If the water is coming through the joint between the wall and the edge of the floor, it is best to cut out a narrow strip of the floor next to the wall and then refill it with mortar.

In cases where the owner desires to have a tile drain

placed around the building, in order to remove the source of the leakage, the trench for the drain may be dug next to the wall. That will permit placing a 1/2-inch coat of 1:3 cement-and-sand mortar, or some commercial waterproofing compound, against the outside face of the foundation wall.

Inasmuch as many basement walls in your community permit leakage or seepage, isn't this your opportunity to specialize in the repair of leaky basement walls? Once you have cured the trouble in a few basements you will quickly be thought of as the man to send for when trouble of that kind appears.

Production of Masonry Cements

I am looking for data on the annual production of so-called masonry cements which comply with government specifications. Where can I obtain this information?—E. C. C., New York, N. Y.

Information on this point may be obtained from the Division of Mineral Statistics, Bureau of Mines, U. S. Department of Commerce, Washington, D. C. For the 5-year period from 1925 to 1929, inclusive, the annual production reported by eleven mills (ten mills in 1925) is as follows:

Year	Barrels of Masonry Cement Produced
1925	1,729,343
1926	2,104,891
1927	2,123,868
1928	2,210,404
1929	2,209,465

Specifications for Tennis Courts

Please tell me where I can get modern specifications for concrete tennis courts, and something in the nature of standard drawings of such courts.—M. L. S., Cincinnati, Ohio.

You will find the information requested in an article in the July (1930) issue of CONCRETE, pages 51 to 53, printed under the title of "Specifications for Concrete Tennis Courts." The article contains, besides the specifications, a drawing showing plans and cross-sections of a standard court.

Glossy Finish on Concrete

Please let me know how to get a glossy finish on concrete cast stone.—A. I. J., New Haven, Conn.

The need for a preparation in the nature of an admixture which will produce a glossy finish on cast stone without requiring mechanical polishing has been receiving considerable attention from commercial concerns.

Several manufacturers now supply such an admixture. A list of these manufacturers will be sent you.

Organizations

AMERICAN CONCRETE INSTITUTE; Harvey Whipple, Secretary, 624 Fisher Building, Detroit, Mich.

AMERICAN CONCRETE PIPE ASSOCIATION; M. W. Loving, Secretary, 33 West Grand Ave., Chicago.

AMERICAN ROAD BUILDERS' ASSOCIATION; Chas. Upham, Engineer-Director, 914 National Press Building, Washington, D. C.
Twenty-ninth annual convention and road show, January 9-15, Detroit Airport building, Detroit, Mich.

AMERICAN SOCIETY OF CIVIL ENGINEERS; Geo. T. Seabury, Secretary, 33 West Thirty-ninth St., New York City.

AMERICAN SOCIETY FOR TESTING MATERIALS; C. L. Warwick, Secretary-Treasurer, 1315 Spruce St., Philadelphia, Pa.

AMERICAN STANDARDS ASSOCIATION; P. G. Agnew, Secretary, 29 West 39th St., New York City.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA; E. J. Harding, Managing Director, 222 Munsey Bldg., Washington, D. C.

BUILDING OFFICIALS CONFERENCE OF AMERICA; Col. John W. Oehmann, Secretary, 1253 Lawrence St., N. E., Washington, D. C.

CANADIAN ENGINEERING STANDARDS ASSOCIATION; 178 Queen St., Ottawa, Ontario.

CAST STONE INSTITUTE; L. A. Falco, Secretary, Chapel St. and Blatchley Ave., New Haven, Conn.

CEMENT INSTITUTE; Luther G. McConnell, General Manager, 11 East 44th St., New York City.

CONCRETE MASONRY ASSOCIATION; Jack Franklin, Secretary, 7071 Plankinton Bldg., Milwaukee, Wis.

CONCRETE REINFORCING STEEL INSTITUTE; M. A. Beeman, Secretary, Tribune Tower, Chicago.

ENGINEERING INSTITUTE OF CANADA; 2050 Mansfield St., Montreal, Quebec.

JOINT COMMITTEE ON STANDARD SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE; F. R. McMillan, Secretary, 33 West Grand Ave., Chicago.

NATIONAL BOARD OF FIRE UNDERWRITERS; W. E. Mallalieu, General Manager, 85 John St., New York City.

NATIONAL CONCRETE BURIAL VAULT ASSOCIATION; J. H. Stuart, Secretary-Treasurer, Bremen, Ohio.

NATIONAL CRUSHED STONE ASSOCIATION; J. R. Boyd, Secretary, 751 Earle Bldg., Washington, D. C.

NATIONAL ENGINEERING INSPECTION ASSOCIATION; B. H. Wither- spoon, Secretary, P. O. Box 1115, Pittsburgh, Pa.

NATIONAL FIRE PROTECTION ASSOCIATION; Franklin H. Wentworth, Secretary, 40 Central St., Boston, Mass.

NATIONAL LIME ASSOCIATION; Norman G. Hough, Secretary and Manager, 927 Fifteenth St., N. W., Washington, D. C.

NATIONAL READY-MIXED CONCRETE ASSOCIATION; V. P. Ahearn, Secretary, 432 Munsey Building, Washington, D. C.
Second annual convention, August 25-26, William Penn Hotel, Pittsburgh, Pa.

NATIONAL SAND AND GRAVEL ASSOCIATION; V. P. Ahearn, Executive Secretary, 432 Munsey Bldg., Washington, D. C.

NATIONAL SLAG ASSOCIATION; H. J. Love, Secretary-Treasurer, 937 Leader Bldg., Cleveland, Ohio.

NATIONAL TERRAZZO AND MOSAIC ASSOCIATION; U. F. Durner, Secretary, 809 St. Paul Ave., Milwaukee, Wis.

NORTHWEST CONCRETE PRODUCTS ASSOCIATION; W. P. Hews, Secretary-Treasurer, Yakima, Wash.

PORTLAND CEMENT ASSOCIATION; William M. Kinney, General Manager, 33 West Grand Ave., Chicago.

RAIL STEEL BAR ASSOCIATION; H. P. Bigler, Engineering Secretary, Builders' Bldg., 228 N. La Salle St., Chicago, Ill.

WISCONSIN CONCRETE PRODUCTS ASSOCIATION; Jack Franklin, Secretary-Treasurer, 425 East Water St., Milwaukee, Wis.

The Concrete Industry -25 YEARS AGO

“CONCRETE Blocks Make Good Building Material,” in the July, 1931, issue of CONCRETE, is a reply to Architect V. O. Wallingford's objections to concrete block, which were published in the previous issue.

His disapproval on the ground of occasional poor quality is not denied, but with the exercise of care in proportioning, thorough mixing, tamping and curing, “we can see no excuse for a poor product.”

In rebuttal to the charge that inexperienced men are engaged in the manufacture of block, it is stated, “No doubt a good many rushed into the block-making business, owing to the fact that small capital was required and that the field offered a ready market for the manufactured article, bringing large returns. They failed—gave the then limited trade poor blocks and injured the business.”

POLITICS and construction of public works were not always asunder in 1906 and CONCRETE saw an instance of it in Detroit as possibly one of the reasons for the opposition frequently met by concrete construction at that time.

Upon completion of two bridges, the township engineer refused to accept them, giving thirteen reasons for his action. One of them was that a poor grade of cement had been used, although certain standard makes had been specified. Also, he claimed, the arches were out of line and the completed structures had been opened to traffic after only 18 days.

A FLOOD of inquiries about cement and concrete caused the U. S. Department of Agriculture to issue its first bulletin on the subject in June, 1906. Portions of it, covering such matters as cement mortar, mixing, cement mortar for plastering, proportioning materials, coloring, rubble concrete, fence posts, steps, etc., are given in the July issue of the magazine.

A PICTURE of what was the longest concrete bridge in the United States in 1906 appears in the July issue of *Cement Age*.

Comprising ten spans of 75 feet each, the San Joaquin river bridge in Pollasky, Fresno County, California, “had heavy end abutments with wing walls extending into the natural banks at either end. The piers are 31 feet long, and 8 feet wide at the base, and the foundation for each pier consists of 33 12 by 12 in. blackheart redwood square piles.”

HOW concrete was used within a steel cylinder to make the foundation for the famous “Mile Rock” lighthouse on a jutting rock about 27 feet square opposite Golden Gate at San Francisco is told by a western correspondent.

After the elliptical steel cylinder foundation was anchored to the massive rock, according to J. Mayne Baltimore, and as fast as it rose to its height of 45 ft., “all wide space between the inner walls was filled with an excellent quality of concrete—mixed in such proportions as to make it very rich. It was placed as dry as practicable, and firmly tamped until perfectly solid.”

New Equipment and Materials

National Equipment Corporation Announces New Smith Truck Mixer and Agitator

The National Equipment Corporation, Milwaukee, Wisconsin, announces the Smith truck mixer and agitator.

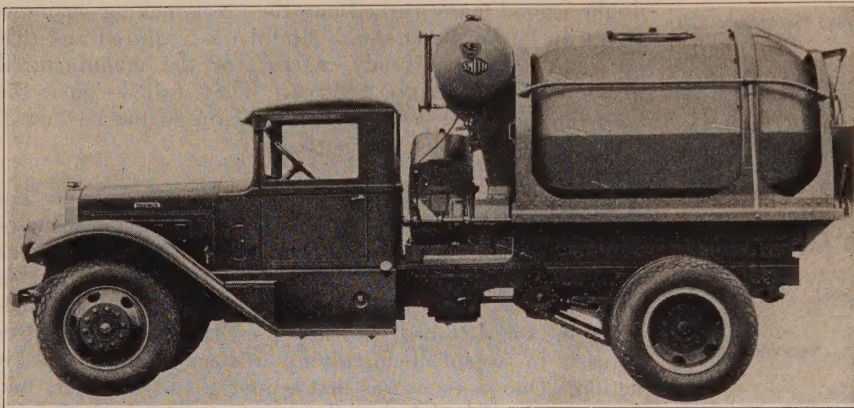
This unit, incorporating many points of unique design, has the following important features, the manufacturer points out:

1. A thorough five-step mixing action,

6. Roller and ball bearing drum support.

7. Simplicity and ruggedness of design—saving of weight and unnecessary mechanism.

This machine is offered in two sizes. The 1-1½ cu. yd. has a capacity of 1 cu.



accomplished by clockwise rotating and without reversing direction.

2. Distinctive egg-shaped drum with twelve-sided panel design.

3. Full control of discharge—fast, slow or intermittent. Positive discharge—no hoisting or tilting of the drum.

4. Adaptable to any make of truck of sufficient capacity.

5. Separate power unit providing longer life of truck and better control.

Solenoid Dripless Scale Perfected for Mixing Plant Use

A solenoid dripless valve for use in ready-mixed concrete plants has recently been perfected which stops all dripping after the valve is closed, an announcement states.

The valve operates on the solenoid principle; that is, when the current is on, the valve is open, and when the current is broken, the valve closes. The valve seat is placed at the outlet, so that no liquid may flow after the valve is closed.

With this valve, exact measures of any liquid are possible as the flow can be instantly stopped, according to the manufacturers. It was designed primarily for use with the Toledo scale electric cut-off weighing device and was perfected by Toledo Precision Devices, Inc., a subsidiary of the Toledo Scale Company,

yd. of resultant concrete as a mixer and 1½ cu. yd. as an agitator. The 2-3 cu. yd. mixer has a capacity in resultant concrete of 2½ cu. yds. and 3 cu. yds. as an agitator. A third size, with a capacity up to 4½ cu. yds. of concrete, will also soon be available.

An illustrated bulletin and complete information can be had on request either from the National Equipment Corporation at Milwaukee or any of its sales representatives.

Toledo, Ohio. It is furnished in ½, 1 and 2-in. sizes.

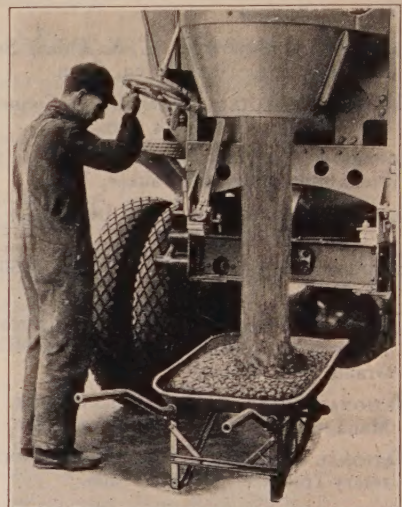
With this attachment the liquid passes through the valve and flows into a container on the scale. As the container fills, the weight of its contents is automatically registered on the scale dial by the indicator. When the indicator reaches any predetermined weight it passes over the electric eye, intercepting a beam of light, automatically cutting off the current and thus stopping the flow through the valve.

Controlled Discharge New Improvement on Moto-Mixer

One of several recent improvements on the Chain Belt Company's Rex Moto-Mixer is the new controlled discharge. At the single turn of a handwheel the concrete can be released at full speed or turned down to a mere trickle. A new spout is

also used to help place the mixed concrete at a greater efficiency into forms. The discharge is made higher than normally and allowance has been made so that the mixed batch can be discharged into various forms or on various jobs at a greater range.

Another improvement is the method by which the entire batch can be discharged regardless of the angle of the truck which has delivered the mixed batch to the job. The Moto-Mixer was engineered to discharge the mixed concrete even though the incline is exceedingly steep. The Moto-Mixer is lighter and lower than any of its previous models. It has a separate mounting. The reduction gears are of



heat-treated steel and are enclosed in a bell housing and operate in a constant bath of oil, according to the manufacturer.

Tensiometer Determines Loads, Weighs Materials

The Hills-McCanna Tensiometer is designed to give the tension on wires, cables and lines quickly and accurately. Its uses in building include the determining of load on cables, especially to prevent overloading and breaking. The sensitivity of the instrument permits its use for weighing materials going into construction, it is stated.

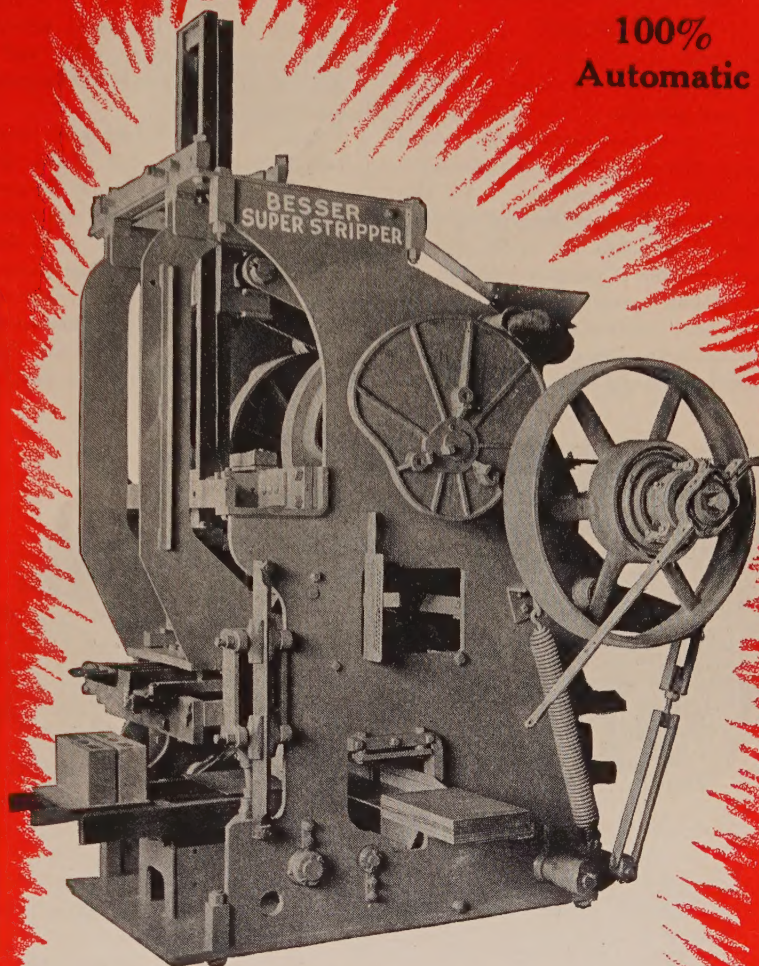
It is also used for taking the deflection, strain or load on steel towers; for determining the load necessary to deflect a pole or tower a certain distance and to determine the load necessary to break a pole for test purposes.

The Tensiometer is a product of the Hills-McCanna Company, Chicago.

The NEW Besser Super Stripper

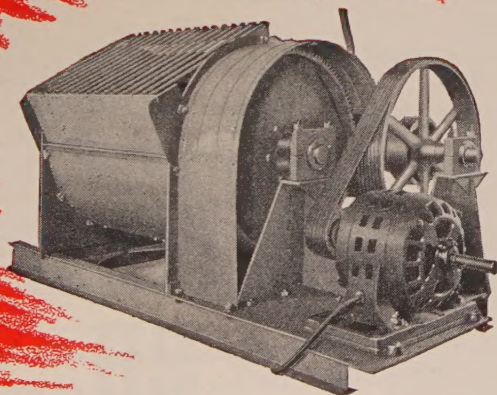
100%
Automatic

For many years the basic principles of Besser Strippers have been accepted as superior by leading concrete products manufacturers. The new Besser Super Stripper has one piece solid steel frame and possesses the mechanical perfection necessary to the most economical operation and the greatest durability. All movements are entirely automatic and positive in results. Besser Strippers pay for themselves in a short time in lower operating costs and the simple design insures long life and care free service. Only one set of plain pallets is required in any Besser equipped plant to make more than 50 different sizes and types of units.



THE SEVEN DIVISIONS OF BESSER SERVICE TO THE CONCRETE PRODUCTS INDUSTRY

1. BESSER SUPER STRIPPER. 7 blocks, 14 slabs or tile or 42 concrete bricks per minute.
BESSER STANDARD STRIPPER. 6 blocks, 12 slabs or tile or 36 concrete bricks per minute.
BESSER VICTORY STRIPPER. 4 blocks, 8 slabs or tile or 24 concrete bricks per minute.
These Stripper Machines make the block on plain pallets and only one set of pallets required for a very large variety of product.
2. BESSER MASTER TAMPER. FACE DOWN MACHINE. 3 to 4 blocks per minute.
3. BESSER BATCH PADDLE MIXERS in Seven Sizes. 5, 12, 18, 25, 30, 40 and 50 cu. ft. capacities.
4. AUTOMATIC CONCRETE BRICK MACHINE. 40 to 50 M per day.
MASTER CONCRETE BRICK MACHINE. 10 to 20 M per day.
5. BESSER SEWER, CULVERT AND DRAIN TILE MOLD. All sizes up to 5 ft.
6. CARS, PALLETS. ELEVATORS, ETC.
7. BESSER FACILITIES FOR SERVICE AND ENGINEERING ASSISTANCE.



BESSER BATCH MIXERS

Recognized by leading concrete products manufacturers for their strength, durability and superior performance. Made in seven sizes

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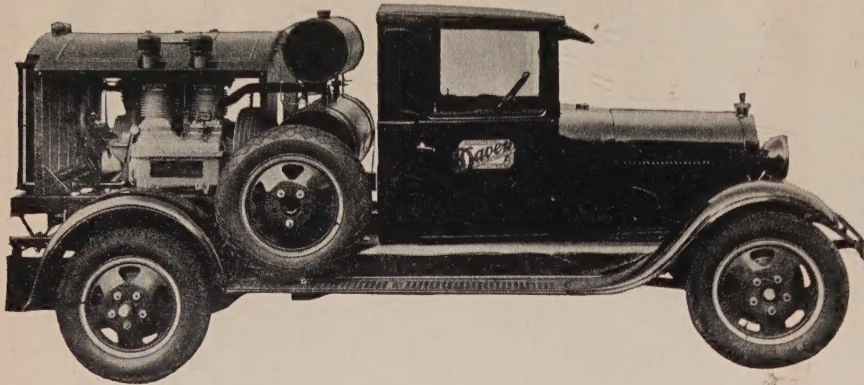
Send for
Illustrated Catalogs
of
Besser Strippers
and
Besser Batch Mixers

110 Cu. Ft. Unit Newest Davey Compressor Product

The latest development in Davey air-cooled portable air compressors is the 110 cu. ft. unit powered by the Ford Model A industrial motor and mounted on a standard short wheelbase Ford truck chassis.

The details and advantages of this unit, as pointed out by the Davey Compressor Co., Inc., Kent, Ohio, are as follows:

Because of the Davey patented principle of air cooling through the use of metals of high heat conducting capacity, excess weight has been eliminated, the combined weight of the compressor and motor hav-



ing been brought down to 2,100 lbs., making it possible to use this compressor in places and under conditions where a heavier water-cooled compressor would be at a disadvantage.

Using the Ford Model "A" industrial motor for the compressor power plant provides the advantage of interchangeability of parts between truck and compressor motor; and also makes available to the user motor service for both compressor and truck motors through Ford service stations, in cases where motor repairs or replacements are needed.

The Ford Model "A" industrial motor drives the Davey compressor through clutch and V-belts; the compressor unit is started by cranking the motor only. With motor running the compressor starts pumping air with a one-finger pull on the clutch lever. Electric starter is supplied for the compressor motor on special order.

This 110 cu. ft. Davey compressor unit can also be supplied on standard trailer mounting using the same Model "A" Ford motor, driving the compressor through clutch and V-belts.

Home-Made Mixture Suggested for Lubricating Open Gears

Operators of cranes, excavating and other machinery will find the following home-made mixture an especially efficient lubrication for open gears: White lead, $\frac{1}{2}$ lb.; cylinder oil, $\frac{1}{2}$ gal.; flake graphite, $\frac{1}{2}$ lb.

It will be found that this mixture adheres well to the gears and that it can be painted on with a brush, as required, at intervals of about five hours, according to G. H. Olson, manager, crane and shovel division of the Link-Belt Company, Chicago, Illinois.

Some of the standard gear compounds may be used with good results, but they have a tendency to run off the gears and get in the frictions of excavating machinery, usually resulting in a dirty machine. However, most of these compounds may be obtained in grades that are suitable for use in various temperatures.

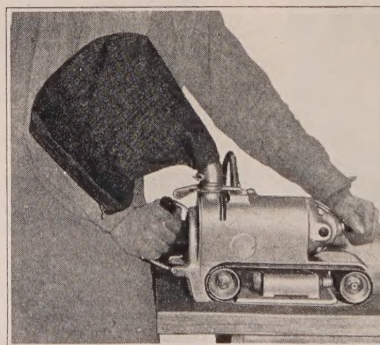
The white lead mixture may be made heavier for warm weather by using less oil

or grease in proportion to the quantity of flake graphite.

Above all, it is important to keep all moving parts properly lubricated for increased life and efficiency.

Portable Belt Sander Has Vacuum System

The first portable belt sander to remove and control dust is its new Model B-10 Dustless Take-About Sander, according to



the Porter-Cable-Hutchinson Corporation, Syracuse, N. Y.

A double blade fan traveling at 10,000 r.p.m. creates a powerful vacuum which draws the dust through ports directly in back of the rear pulley and deposits the dust in the bag. Dust is removed from the bag through the zipper opening. The bag is detached from the machine by a twist of the coupling.

Removing the film from the curved and round as well as the flat surfaces of cast

stone with the Take-About surfacer can now be done in a fraction of the time required by the hand rasp method, it is also said.

Industrial Literature

The Harm of Smoke

A 6-page technical data sheet entitled "Corrosive Disintegration of Concrete with Particular Reference to the Corrosive Character of Smoke Deposits," has been issued by the Master Builders Co., of Cleveland, Ohio.

Contents include such subjects as The Methods Used to Protect Concrete Floors, A Further Cause of Premature Failure Indicated, Corrosive Disintegration as a Primary Cause of Concrete Floor Failure, and The Chemical Nature of Smoke Deposits.

Notes from the Field

Erickson Joins Miles

J. A. Erickson has joined the Miles Manufacturing Company of Jackson, Mich., as technical service engineer.

Mr. Erickson has for the past five years been associated with the Universal Atlas Cement Co. as a technical service engineer and previously he spent eight years in the concrete products industry, during which he applied his theoretical knowledge to the practical problems of machinery and the economical manufacture and sale of concrete products.

Ryerson Purchases Reed-Smith

In 1924 Joseph T. Ryerson & Son, Inc., purchased the interest of W. J. Reed and others in the Reed-Smith Company of Milwaukee, Wisconsin. Now the Ryerson Company has purchased the remaining stock and the firm becomes the Reed-Smith plant of Joseph T. Ryerson & Son of Wisconsin, Inc.

Cement Gun Office Moves

The new location of the New York City office of the Cement Gun Construction Company is 1169-1171 Woolworth Building.

Andrews Is Blaw-Knox Vice-President

The Blaw-Knox Company announces the appointment of Roger W. Andrews, now assistant to the president, as vice-president and a director of Blaw-Knox International Corporation. Mr. Andrews will reside in Paris and will be in charge of the company's European activities, which have been growing considerably for the past few years. He will take the place of C. T. Clack, who recently died in Dusseldorf, Germany.